THE HEATING AND VENTILATING MAGAZINE

1123 BROADWAY NEW YORK JANUARY, 1906

Twelfth Annual Meeting of the American Society of Heating and Ventilating Engineers

Rooms of the American Society of Mechanical Engineers, 12 West Thirty-first Street New York

Newly-Elected Officers—1905-1906

PRESIDENT
John Gormly, Philadelphia, Pa.
FIRST VICE-PRESIDENT
C. B. J. Snyder, New York.
SECOND VICE-PRESIDENT
T. J. Waters, Chicago, Ill.
SECRETARY
William M. Mackay, New York.
TREASURER
U. G. Scollay, Brooklyn, N. Y.
BOARD OF GOVERNORS
R. C. Carpenter, Ithaca, N. Y.
B. F. Stangland, New York.
James Mackay, Chicago, Ill.
A. B. Franklin, Boston, Mass.
Frank K. Chew, New York.

Judging by all available indications, the twelfth annual meeting of the American Society of Heating and Ventilating Engineers, which is in session as we go to press, will go down in the society's history as one of the best attended, at least, of any of its meetings. The program, too, offers so many opportunities for profitable discussion that the full reports of it, which will be presented in detail in our February issue, should make most interesting reading.

Following is the program of the meeting:

FIRST DAY—AFTERNOON SESSION

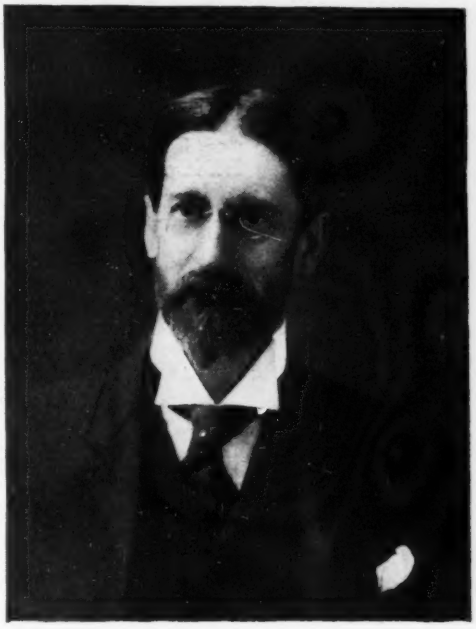
Tuesday, January 16, 2 o'clock

Roll Call.
Reading of Minutes of Previous Meeting.
President's Address.
Report of Secretary.
Report of Treasurer.
Report of the Board of Governors.
Reports of Standing Committees.
Reports of Special Committees.
Appointment of Tellers.
New Business.

EVENING SESSION

Tuesday, January 16, 8 o'clock

Report of Tellers.
Reading of Paper—"Heating and Ventilating the Main Auditorium of the Broadway Tabernacle," by C. Teran (member of the Society).
Discussion.
Reading of Paper—"Some Features of the Heating and Ventilating System in the Bellevue-Stratford Hotel, Philadelphia," by Wm. G. Snow (member of the Society).
Discussion.
General Discussion.



REGINALD PELHAM BOLTON, NEW YORK
Nominated for President

SECOND DAY—AFTERNOON SESSION

Wednesday, January 17, 2 o'clock

Reading of Paper—"Arrangements for the Ventilation of the Debating Rooms of

C. B. J. SNYDER, NEW YORK
Elected First Vice-President

B. HAROLD CARPENTER, WILKES-BARRE, PA.
Nominated for First Vice-President

the new Riksdag's Building in Stockholm, and the results obtained in this respect," by Wilhelm Dahlgren, Stockholm, Sweden (member of the Society).

Discussion

Report of Committee on Collection of Data on Furnace Heating.

Discussion.

Topics for Discussion:

No. 1. "The increased tax on indirect heating apparatus, due to the use of partition flues, owing to their shape and restricted area."

No. 2. "The difference between the theoretical estimate and the actual consumption of fuel required for heating buildings."

General Discussion.

T. J. WATERS, CHICAGO, ILL.
Elected Second Vice-President

WILLIAM J. BRYAN, ST. LOUIS, MO.
Nominated for Second Vice-President

WILLIAM M. MACKAY, NEW YORK
Re-elected Secretary

THOMAS BARWICK, NEW YORK
Nominated for Secretary

WEDNESDAY EVENING, JANUARY 17

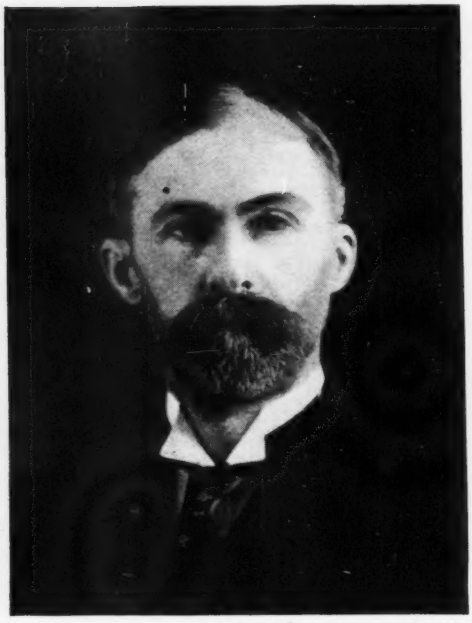
Annual dinner of the society at the New Grand Hotel, Broadway and 31st street, at 6:30 o'clock.

THIRD DAY—MORNING SESSION

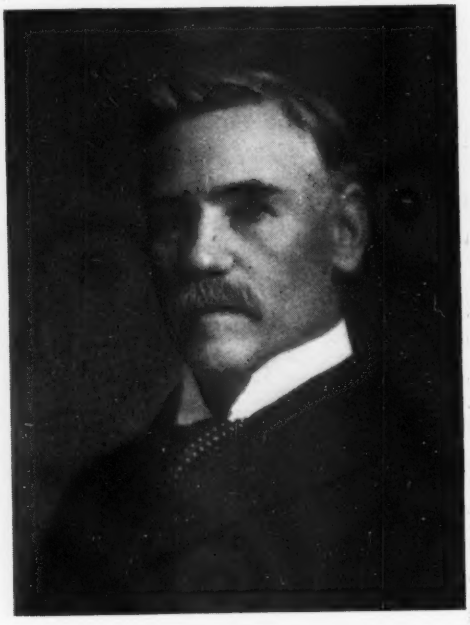
Thursday, January 18, 10:30 o'clock
Reading of Paper—"Power Required to Thread, Twist and Split Wrought Iron and Mild Steel Pipe," by T. N. Thomson (member of the Society).
Discussion.
Reading of Paper—"Sizes of Return Pipes in Steam Heating Apparatus," by J. A. Donnelly (member of the Society).
Discussion.

U. G. SCOLLAY, BROOKLYN, N. Y.
Re-elected Treasurer

H. A. JOSLIN, NEW YORK
Nominated for Treasurer



B. F. STANGLAND, NEW YORK
Nominated for Board of Governors



PROF. R. C. CARPENTER, ITHACA, N. Y.
Nominated for Board of Governors

Topics for Discussion:

No. 3. "Is there any advantage in placing check-valves on return connections of Steam Radiators, discharging into a single down pipe from an overhead Steam Main, returning to a receiver? And if so, can check-valves be used of smaller size than the return connection?"

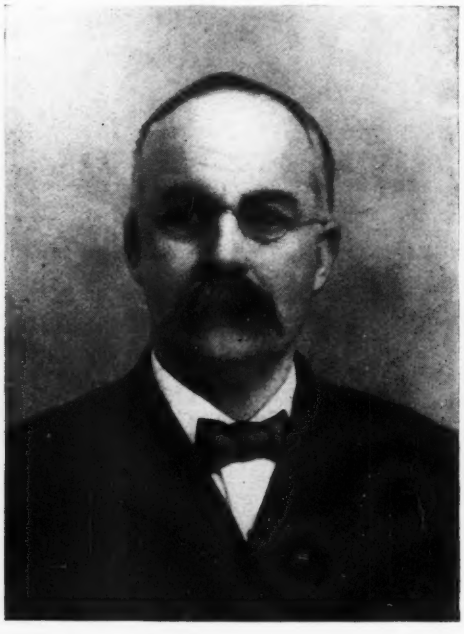
No. 4. "The advantage of automatically venting the extreme ends of steam mains in the basements on low pressure gravity steam heating apparatus, and the proper mode of connection."

General Discussion.

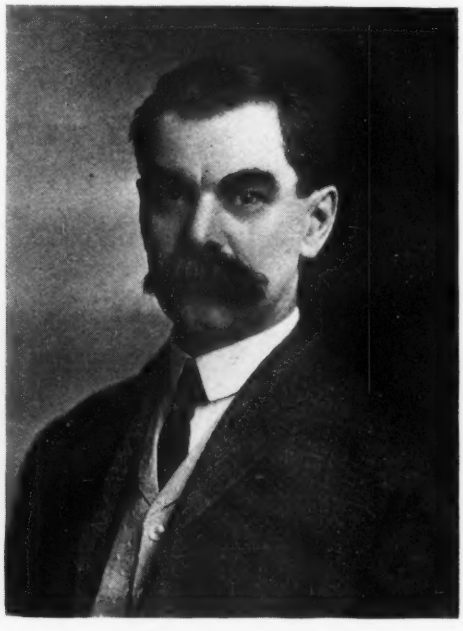
THIRD DAY—AFTERNOON SESSION

Thursday, January 18, 2 o'clock

Reading of Paper—"A New Vapor Vacuum

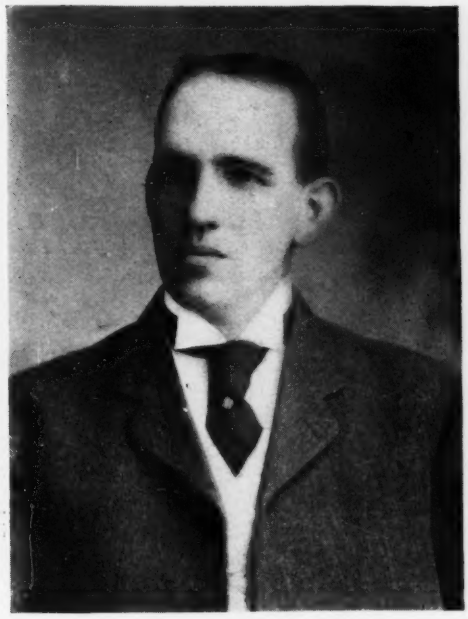


A. B. FRANKLIN, BOSTON, MASS.
Nominated for Board of Governors



JAMES MACKAY, CHICAGO, ILL.
Nominated for Board of Governors

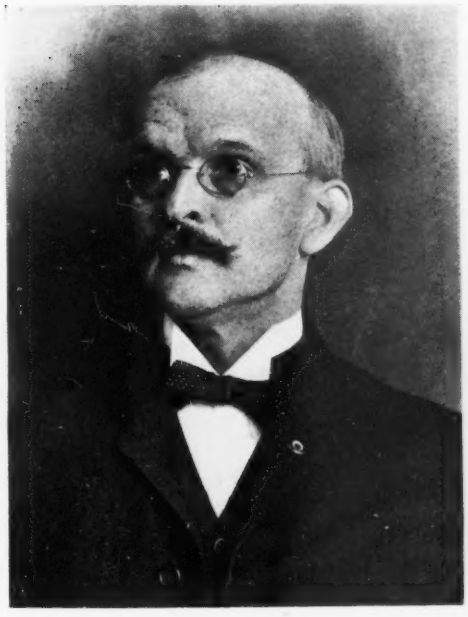
WILLIAM G. SNOW, BOSTON, MASS.
Nominated for Board of Governors



HENRY L. HALL, NEW YORK
Nominated for Board of Governors

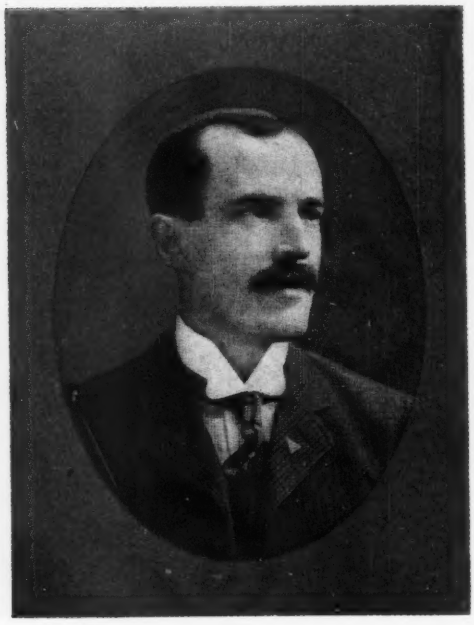
System of Steam Heating," by J. A. Donnelly (member of the Society).
Discussion.
Reading of Paper—"Forced Draft for Boilers," by L. J. Wing (member of the Society).
Discussion.
Reading of Papers.
Installation of Officers.

New Officers Assume their Duties.
Topics for Discussion:
No. 5. "The advantages and disadvantages attending the use of the thumb rules."
No. 6. "The effect of exhaust fans for ventilating rooms heated by direct radiators."
General Discussion.



FRANK K. CHEW, NEW YORK
Nominated for Board of Governors

JAMES H. DAVIS, CHICAGO, ILL.
Nominated for Board of Governors



BURT S. HARRISON
Nominated for Board of Governors

J. J. BLACKMORE, NEW YORK
Chairman Standards Committee

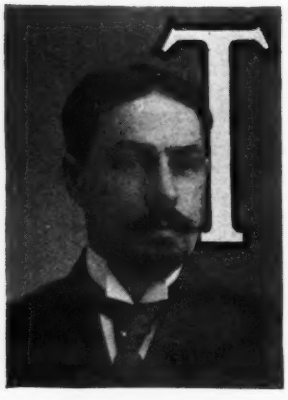
Suggestions for the advancement of the Society are invited from the members. Adjournment.

In the following pages will be found all of the papers presented at this meeting up to the Thursday afternoon session.

Heating and Ventilating the Main Auditorium of the Broadway Tabernacle, New York

By C. Teran (Member of the Society)

A Plan of the Basement, Showing the Design of This System Will Be Found on Pages 22-23



CESAR TERAN

THE heating and ventilating of a church auditorium has always been an interesting problem, for there are conditions found, and difficulties to overcome, in an auditorium of this kind that do not occur in the ordinary building, such as large glass surfaces, which are the source of cold drafts, little floor space for placing radiators, the necessity of placing radiators near seats, making these seats undesirable.

In this case there was one difficulty to contend with, namely, that under the auditorium there is a hall, which had to be left free of pipes and other objectionable features from an esthetic point of view; in other words, there is no cellar in which pipes and ducts could be placed. A space between the auditorium and the ceiling below was provided for this purpose. This space is about three feet deep, but as it is due to the depth of the girders that carry the floor its usefulness for placing pipes and ducts was limited, as can readily be understood.

After carefully considering all these points it was desired to use the blast system of heating, with mechanical exhaust and automatic temperature control for the auditorium, and direct radiators controlled by hand for the vestibules.

The blast system was considered the best in this particular case for the following reasons:

First—Low cost of installation.

Second—The objectionable radiators are done away with.

Third—From a sanitary point of view the fact that the place cannot be heated without at the same time ventilating it.

Fourth—Even distribution of heat.

The seating capacity of this auditorium is 1,500. The apparatus was designed to

supply 25 cubic feet of air a minute per person to 1,600 persons, or a total of 40,000 cubic feet of air a minute.

It may be mentioned that in this case 25 cubic feet a minute per person was about the maximum amount of air that could be introduced without causing drafts and noise, and this by introducing a large proportion of the air through top inlets. The entire use of bottom inlets would have been impossible without causing drafts, or considerably reducing the amount of air supplied.

A three-quarter housed centrifugal fan is used to supply the air. This fan has a blast wheel 9 feet in diameter by 4½ feet wide, and is driven by a direct connected motor. The fan is calculated to deliver 40,000 cubic feet of air a minute at 130 R. P. M.

The heat transmitted through walls, windows, etc., was calculated to be 340,000 B. T. U. per hour, with 70 degrees Fahrenheit difference between the inside and outside temperature. Given these conditions, the incoming air would have to be heated to 78 degrees Fahrenheit to supply this loss. This is accomplished by drawing the air through a heating stack, consisting of ten two-row sections, or coils, of the miter type. These coils are built in staggered rows of 1-inch pipe, and the stack contains 7,500 lineal feet. Each section has two steam and one return connection. The air is taken from a court at the ground level, and for this reason the intake was made large, to insure a low velocity of the air in the immediate outside vicinity. This opening is fitted with a wire screen and louver damper. Through this opening the air is directly admitted to the filter room. The filter is of the "V" type, made of galvanized iron, with removable wooden frames, covered with wire and cheesecloth in the usual manner. The filtering area is proportioned to allow 32 cubic feet of air a minute to pass through every square foot of filtering material.

From the filter room the air is induced through the heating stack into the fan, then discharged by this into the distributing ducts and flues, leading to the auditorium.

The velocity of the air is reduced in the ducts to 1,900 feet a minute, and in the flues to 900, and finally discharged at 600 through the top registers and 200 through the floor registers.

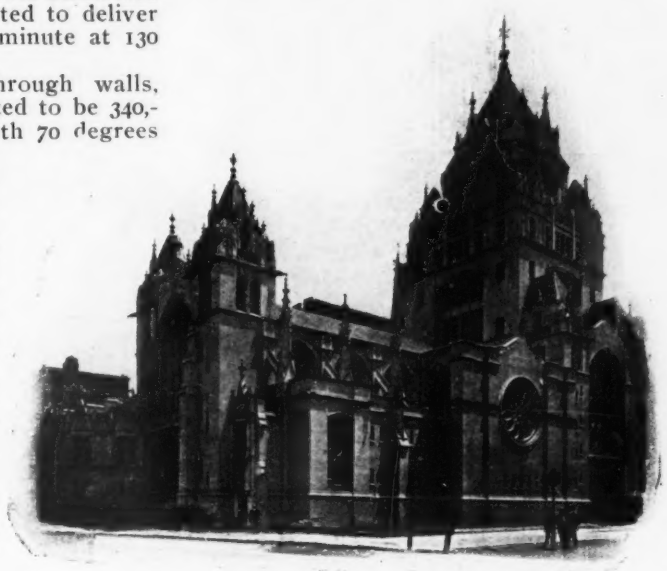
The heat registers are placed from 8 to 12 feet above the main auditorium and gallery floors.

There are also heat registers in the floor in front of the large windows, and in the step risers of the front gallery.

The air discharged by the registers in front of windows is intended to counteract the cold air drafts produced by these cooling surfaces.

A large proportion of the air is introduced on the same side as the pulpit, so that its travel is in the same direction as the voice of the speaker, thus aiding, or at least not interfering with the acoustics of the auditorium.

The equal distribution of the air is obtained to a large extent by the location of the exhaust openings.



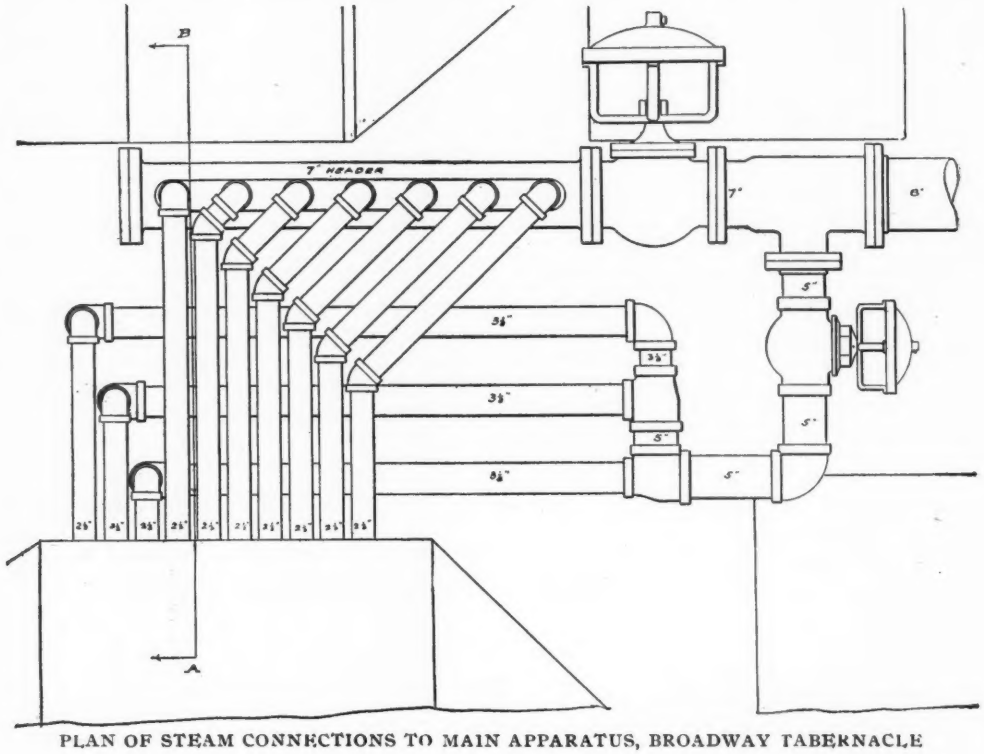
BROADWAY TABERNACLE, NEW YORK

Each pew end on the main floor has an opening near the floor, forming part of the design of the ends of the pews, these openings are connected with the space underneath the auditorium before referred to, which is also used as an exhaust chamber.

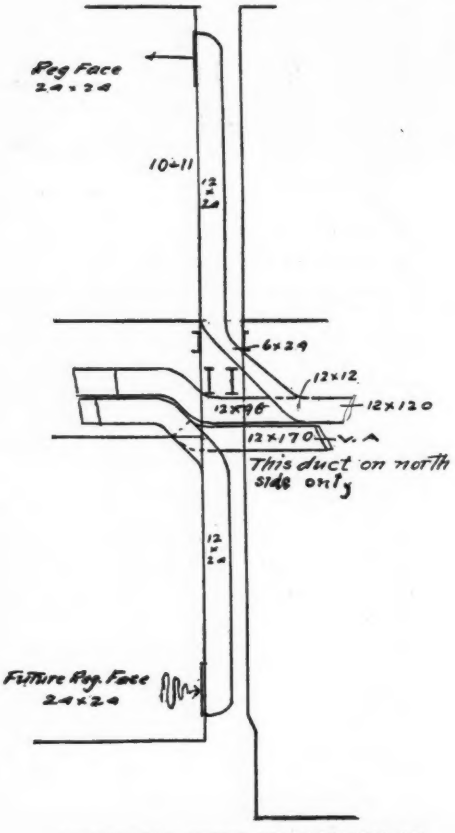
The connections between this chamber and the openings in the pew ends are made by cast-iron hoods, placed against the inside of the pew ends, and covering both the opening in the pew end and that in the floor leading to the exhaust chamber. These hoods are provided with controlling dampers, to regulate the flow of air through them.

The exhaust chamber is connected at one end to a Blackman exhaust fan 6 feet in diameter. This fan is driven by a direct connected motor and discharges into the open air. It is intended that when this fan is revolving at 300 R. P. M. it will exhaust 32,000 cubic feet of air a minute, or 80 per cent. of the amount supplied by the blower.

When the apparatus is started in oper-

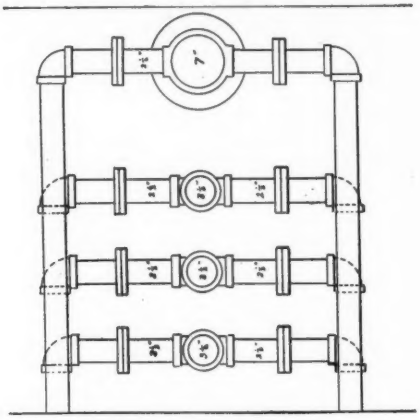


PLAN OF STEAM CONNECTIONS TO MAIN APPARATUS, BROADWAY TABERNACLE



SECTIONAL VIEW OF PORTION OF VENTILATING SYSTEM

ation the air is introduced at as high a temperature as the heater coil will heat it, until the temperature in the auditorium has reached the maximum required, then the air is introduced tempered only until the temperature in the auditorium falls below the normal, when the air is again heated to a higher temperature to supply the loss.



SECTION A-B OF STEAM CONNECTIONS

This is accomplished automatically by thermo-pneumatic control, as follows:

Three sections of the heating stack have separate steam connections and are controlled by a thermostat placed in the cold air chamber. This thermostat is set

to operate at a temperature a few degrees above freezing, about 40 degrees Fahrenheit.

The rest of the heating stack is controlled by two thermostats, one placed in the auditorium and set to operate at 65 degrees Fahrenheit, and the other in the main warm air duct, also set to operate at 65 degrees Fahrenheit. Both of these thermostats operate the same set of valves, controlling the inner seven sections of the heating stack.

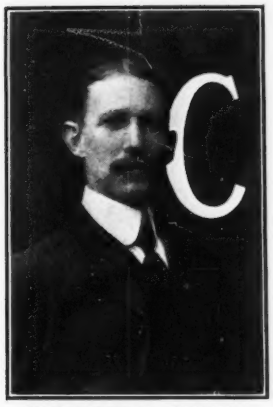
The thermostat in the duct, however, is so connected that it can only act when that in the auditorium has operated to shut off heat, during which period of time it will maintain the air at the temperature at which it has been set. By this arrangement the same stack is alternately used as a heating and tempering coil.

In this, as in all other auditoriums, the heating apparatus is shut down until a short time before audience is admitted. On this account there is a desired advantage in having the tempering and heating coils combined in one, for when heat is turned on the whole stack is active until the required temperature is attained in the auditorium. This makes the period of heating up shorter than it would be if the tempering and heating coils were separate.

The apparatus has been in operation for some months, and although weather conditions have not been favorable for an exhaustive test, the tests that have been made show that it gives the desired results.

Some Features of the Heating and Ventilating System in the Bellevue-Stratford Hotel, Philadelphia

By Wm. G. Snow (Member of the Society)



WILLIAM G. SNOW

CERTAIN features or details of the heating and ventilating system installed in the Bellevue-Stratford Hotel are, it is hoped, of sufficient interest to warrant the presentation of this paper.

The building itself is of considerable magnitude, having a frontage of about 185 feet, a depth of approximately 183 feet, and containing eighteen floors, besides basement and sub-basement.

When the extension is built to its full height the building will contain 827 bedrooms, 566 bathrooms, and the total cubic contents of the twenty floors will exceed 6,000,000 cubic feet.

There will be, in round numbers, 67,000 square feet of cast-iron direct radiation and 14,000 linear feet of 1-inch pipe in heaters.

Five 300 H. P. water-tube boilers, equipped with automatic stokers, furnish steam at about 125 pounds pressure to a 12-inch loop extending across the boiler fronts and around the engine room, as shown in Fig. 1. Two valves were placed in each boiler connection. Standard pipe and extra heavy flanged fittings were installed. An extra heavy ribbed by-pass gate valve was inserted between branch connections to boilers, engines or pumps, these branches being connected at the top of crosses, the bottom outlet having a drip leading to a steam loop system for returning the high-pressure drips to the boilers without the use of pumps or traps.

By means of the above-described arrangement of valves and piping any unit can be temporarily cut out without interfering with the operation of other parts of the system.

The exhaust steam used for heating is first passed through a combined muffler tank and separator with by-pass, and is discharged through an 18-inch riser. Owing to the great height and weight of this pipe, extra heavy fittings were used at the bottom to safely support the load. The back pressure valve located just below the exhaust head is fitted with a by-pass to provide for overhauling it without shutting down the plant.

When possible all apparatus was installed in duplicate, each piece being large enough for the entire system.

Live steam when necessary is admitted to the exhaust main supplying the heating system through two reducing valves set tandem, one of high-pressure pattern and the other of vacuum-pressure pattern, so called, having an outlet about twice the diameter of the inlet.

It was considered better practice to reduce the pressure from that in the boilers to that in the heating system by two stages, rather than reduce it in one operation from about 125 pounds to a pressure of a pound or less. A better control is thereby secured and the valves will wear longer.

In arranging the distributing system it was considered advisable to feed all floors above the first on the down-feed system and all floors below that on the up-feed system. This arrangement permitted the use of small pipes through the lower floors, on which, in buildings of this character, the rooms and windows are large, leaving but few partitions or wall spaces in which pipes may be concealed.

Much of the expansion of the risers is taken up in the attic, where all branches to risers are arranged with properly placed nipples and elbows to provide swing joints.

The risers are anchored at two points and contain two expansion joints of the

Care was taken in making radiator connections to provide for expansion by means of a sufficient number of nipples and elbows, so arranged that no strain would come on the fittings.

In nearly all cases it was possible to set the radiators below the window sills. The top of the mahogany enclosure was made to lift on hinges; the front, running in grooves, can be lifted out.

All woodwork in connection with these enclosures was protected with asbestos air cell covering ½-inch thick covered with galvanized iron, screwed on. Asbestos covering was nailed to the brick work at the back of these enclosures and a hard coating of plaster applied to make a smooth finish.

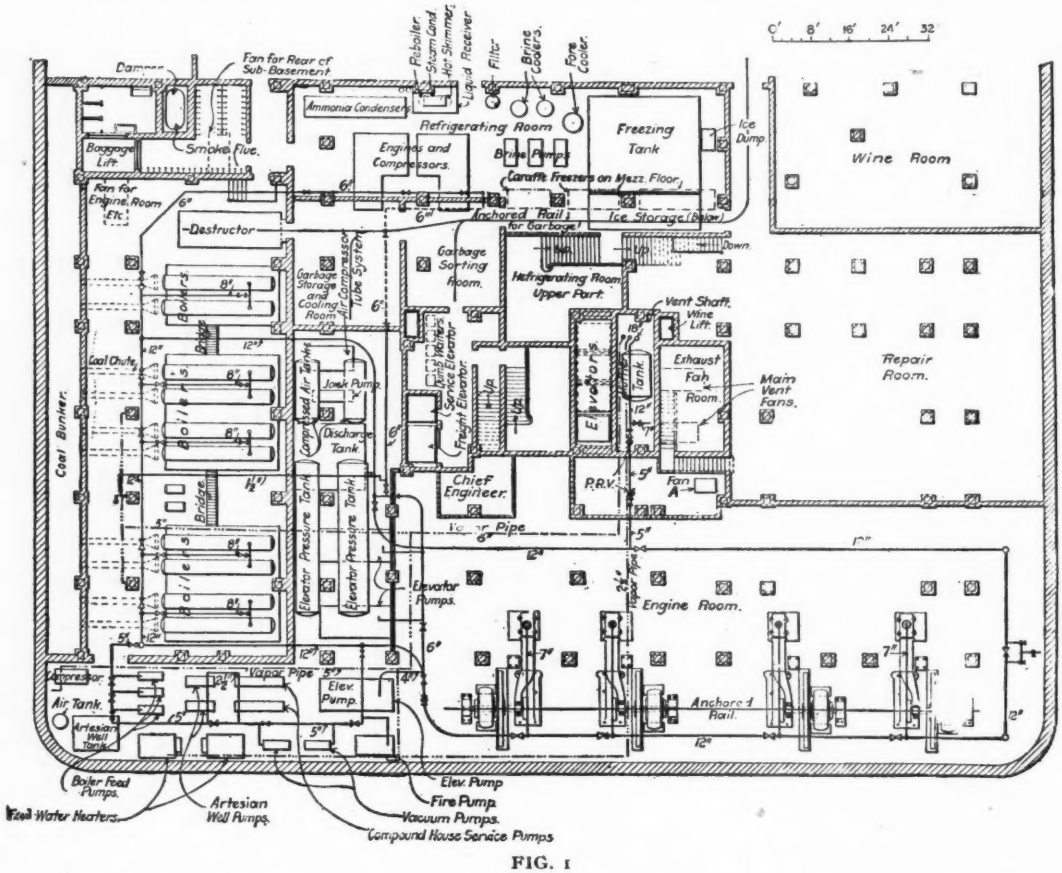


FIG. 1

type illustrated in Figure two (2). Ample space was provided in which to conceal these joints, owing to the fact that in this building the distance from ceiling to floor in each case is about 2 feet, the ceiling being suspended some distance below the fireproof floors. In the case of only one riser was it necessary to use expansion joints of the packed type. Access to the joints on this line is provided through doors. There was no difficulty in concealing the risers, as space was provided in the building construction between the inner and outer walls.

The inlet to each radiator was through a register face of mouse-proof pattern proportioned on the basis of 2½ square inches of net area per square foot of radiation. The outlets in the top of the enclosures were of plain lattice pattern based on an area of 3 square inches per square foot of radiation.

All radiation was worked out on a wall and glass basis, due allowance being made for the cubic contents. This method gave ratios of about 1 to 50, 60 and 70 respectively for rooms on the north, east and south. Northwest corner rooms

figured about 1:35, northeast rooms 1:40, and bathrooms about 1:30 to 1:35. In large rooms like the main dining-room, located at the southeast corner of the building and containing approximately 95,000 cubic feet, the ratio is 1:82 for concealed direct radiation. In this room, which is 20 feet in the clear, the glass is 45 per cent. of the total exposure. The windows are double.

In the Palm Garden, exposed toward the west and containing 77,000 cubic feet, direct-indirect radiators are used, connected with the blower system. Here a ratio of 1:148 gives satisfactory results, the ratio of glass surface to exposure being about the same as in the main dining-room. The ratios throughout were used merely as a rough check on the amount of radiation computed on the basis stated above.

Owing to the fact that the direct radiators were concealed it was assumed that they would give off only 175 heat units in place of the usual allowance of 250 H. U. per square foot per hour.

On the lower floors, up to the sixth, two sets of double hung windows are used to shut out noise and dust; this permitted the use of a smaller amount of radiation than usual in proportion to the contents, the transmission loss through these windows being taken as three-fifths the amount through single windows.

To permit the control of room temperatures by guests to suit their wishes, a long stem supply valve was used on each radiator, the wheel coming just outside of the enclosure. A special valve used in connection with a vacuum return line system was placed at the return end of each radiator.

At the entrance to the building Van Kannell revolving doors are used over which coils are placed, admitting cold air from the street and discharging it through openings overhead, thus introducing large volumes of hot air where most needed.

While it would have been preferable to introduce the heat near the floor at these points, it was impossible to secure suitable radiator locations owing to the decorations or to the arrangement of furniture.

By installing a sufficient amount of surface in the manner described, it has been possible to keep the corridors perfectly comfortable.

Thermostatic control was applied in the principal rooms controlling diaphragm valves on the radiators. The temperature of the air supplied was controlled in a similar manner by cold air and warm air thermostats placed in the ducts controlling diaphragm valves on the heaters. A supplementary heater connected with the buffet was independently controlled by a thermostat placed in the room. Thermostats were used of a type that cannot be tampered with without unscrewing the face.

The heating of the principal rooms was treated independently from the ventilation, with the exception of the buffet in the basement.

The greater portion of this room is below the street level. The exposure is so small that it was deemed better to heat it by means of a supplementary coil placed in the sub-basement designed to re-heat the air supply than to heat the room by direct radiation. This method of heating the buffet was the simplest and least expensive, a re-heater of 300 square feet of surface serving to heat the room containing 82 000 cubic feet.

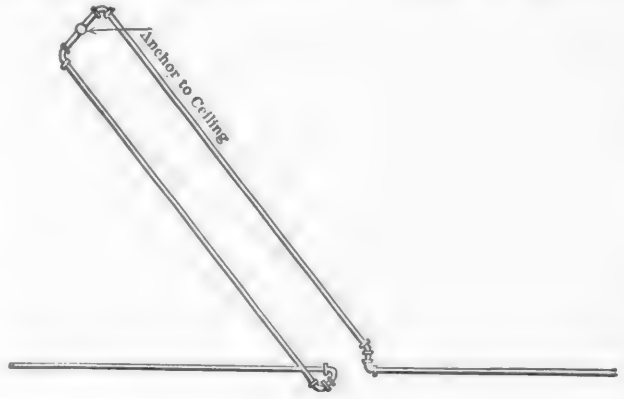


FIG. 2

In the café and some other important rooms the fresh air is admitted through flue radiators placed under the windows, this arrangement giving a better distribution of air than could be secured with flues located in the only spaces available.

In the main and the private dining-rooms the heating is done entirely by direct radiation, the air being supplied at 70 degrees temperature through openings in the walls about 10 or 12 feet from the floor.

The rooms on the main and first floors are approximately 20 feet and 17 feet in the clear respectively, the fresh air inlets being located a little higher than usual to suit the decorations.

In the ventilation of rooms, the outlets are located near the floor, except in rooms where smoking takes place. In these they are placed in the ceiling, the openings being concealed by rosettes or stucco work incorporated in the scheme of decoration, making a very effective system and avoiding the use of wall registers.

The air supply in such rooms is, as a rule, brought in through flue radiators located below windows, this system of upward ventilation removing smoke at once from the breathing plane.

In most cases the galvanized iron air supply and vent ducts were placed above corridor ceilings, the sizes being based on velocities of 700 and 600 feet per minute, respectively, with somewhat lower velocities at the extreme end.

Register sizes were based on a velocity of approximately 400 feet per minute through them.

The change of air in buffet, café and rooms where smoking takes place is approximately once in ten minutes. The air change in the main dining-room is once in fifteen minutes.

In certain rooms used sometimes for banquets and at other times for readings and entertainments, top and bottom ventilating openings were provided so that the air can be withdrawn from near the ceiling or the floor, as desired.

A departure from the common practice of locating fans in the basement was made in this building, in which the main supply fans are located in the attic.

Reasons which led to this choice were lack of suitable space in the basement or sub-basement for the air supply fans and the fact that, by locating them at the top of the shafts instead of at the bottom, branch supply ducts could be taken from the main shafts, which are gradually reduced in size, making them smallest on the lower floors where space is most valuable. The separate set of up-discharge flues necessary when supply fans are located in the basement is avoided.

The air is taken from points just above roof and passed through ordinary cheesecloth filtering screens. Except for particles of soot the air at this high level is practically free from dust. These fans, which are 7 feet diameter, are driven by direct connected 25 H. P. motors at a speed of 220 revolutions per minute, corresponding to ¾ oz. pressure per square inch over an area within their capacity, forcing the air down vertical shafts a distance of over 250 feet to the rooms on the lower floors. These shafts were carefully plastered on the inside with Portland cement smoothly finished, making them as nearly air tight as possible, because with the great length the leakage would be considerable unless carefully guarded against. The air was tempered by steam coils before passing through the fans.

It was found during the most severe winter weather that no trouble was experienced in forcing an adequate volume of tempered air down the shafts, although, had it been possible to so arrange the system, the tempering coils would have been placed at the foot of the shafts instead of in the attic, thus permitting the forcing of cold air down these flues, which could have been done with much less resistance than in the case of warm air. These fans delivered in winter weather approximately 70 per cent. as much air as they would be rated to do when connected with an ordinary system of horizontal ducts.

While an air supply secured by fans located in the attic or on the roof is not uncommon with low buildings, I am not aware that it has been successfully applied elsewhere in buildings as high as the one described.

To prevent the transmission of sound the fans and attached motors were mounted on compressed cork 1½ inches thick, with the result that no trouble from noise was experienced in the sleeping rooms on the floor below them.

A separate fan delivering cold air to the boiler and engine room was installed, discharging through ducts with branch outlets turned down to blow directly toward the floor.

The removal of air from these rooms takes place through the boilers themselves and through the main ventilating fans.

The kitchen has its separate air supply designed to furnish tempered air forced down through outlets placed at intervals around the range, the exhaust ventilation from the range hood taking place through a steel plate flue carried independently to the roof, a steam jet being introduced to provide for extinguishing fires which occasionally occur in this flue.

The general ventilation of the kitchen is accomplished by main exhaust fans in the sub-basement and by ducts leading to the space around the steel plate smoke stack. No air is supplied other than that around the range, it being desired to maintain a slight vacuum condition in this room so that all leakage through doors and openings will be inward.

The exhaust ventilation of the principal rooms is effected by two 7-foot fans driven by direct-connected 20 H.P. motors run at a speed of 220 R. P. M. located in a room in the sub-basement.

Ducts lead from this suction chamber to rooms in the basement and on the main and first floors, some of the air being drawn down a vertical distance of about 75 feet, besides traveling a distance horizontally of 240 feet.

The public toilet room is connected with a separate ventilating fan of the blower type.

Fireplaces, of which there are 297 throughout the building, are connected with three 90-inch fans located in the attic. They are designed to run at a speed of 320 revolutions per minute and are driven by 7½ H. P. direct-connected motors.

All water closets in bathrooms have a 2-inch local vent connected with pipes leading to 70-inch exhaust fans of the blower type placed in the attic. Three

of these fans are used to remove the air from 566 bathrooms. They are run at a higher speed than any others in the building, owing to the small size and great length of the pipes connected with them. They are driven by 6 H. P. direct-connected motors at a speed of 470 revolutions per minute.

The ballroom, containing about 250,000 cubic feet, is heated by direct radiation, and has a separate system of ventilation, so that it can be used independently of any other part of the building.

Two 90-inch fans were provided, to be located in the attic with tempering coils for forcing down the supply of fresh air to registers located around three walls of the room below the balcony. It was impossible to introduce flues on the exposed side of the room, owing to space taken by windows.

Ventilation takes place through ceiling openings connected with an extensive system of ducts leading to two 4-foot exhaust fans of the propeller type, driven by direct-connected electric motors.

The ballroom system was designed to change the air once in ten minutes.

HEATING OF WATER SUPPLY

The heating of the water supply is an important item in a building of the size and character of the Bellevue-Stratford Hotel, and comes under the general title of this paper. Two 1,000-gallon hot water generators were used, the cold water supply to these first passing through coils in the drip tanks.

Either exhaust or live steam can be used in these generators, two thermostats being supplied to control the admission of steam. The one for live steam it set at a little lower temperature than the one for exhaust, so that in case the supply of exhaust steam is insufficient to give the desired temperature, live steam is supplied at a reduced pressure of 15 pounds.

When steam at this pressure is admitted, it closes a swing check valve on the exhaust steam supply line until the temperature of the water rises to a point where live steam is no longer needed.

These generators are located some distance above the feed water heaters to which the drips are trapped.

Arrangements for the Ventilation of the Debating-Rooms of the New Riksdag's Building in Stockholm

And the Results Obtained in This Respect

By Wilhelm Dahlgren, Stockholm, Sweden (Member of the Society)

The object of the following paper is to contribute to the solution of a ventilating question which has been and is the subject of much debate. This question is: In a meeting room with fixed seats—such as the auditoriums of theaters, concert-rooms, debating-rooms and the like—is it best to introduce fresh air near the floor and carry off the vitiated air near or at the ceiling, or vice versa.

A new Riksdag's (Parliament) Building has just been built in Stockholm, which has been in use for one winter—and one summer—session. The above-named question had already been broached when the ventilating system for this house was planned, some ten years ago, but was then one of greater uncertainty than it is now. The resolution was, therefore, come to, to employ a double system, i. e., to make it possible for the fresh air to pass from below upwards, and also from above downwards. Both systems were to receive equal justice, and were to be treated with equal care, and experience was to decide which of the two systems was the more satisfactory.

The Swedish Riksdag consists of two chambers. The First Chamber consists, from the method of election, of persons belonging to the higher and wealthier classes, and, it may be said, of persons who are much past middle age. The Second Chamber is elected by "popular" vote; its members consist, only in a small degree, of persons of the same class as those in the First Chamber, the majority being peasants, tradesmen and workmen. This state of things is of no small importance for the right understanding of the circumstances which exist in connection with the question of the system of ventilation.

Both Chambers have perfectly similar debating-rooms, with but that difference which is necessitated by the fact that the members of the First Chamber number 150, and those of the Second Chamber 230. The areas of the two floors, then, are in proportion to these figures, as the debating-rooms are constructed for a corresponding number of seats. The rooms are octagonal in shape, with the highest part circular in form, and have, on six sides, galleries for the accommodation of the public. The seats for the members of the Riksdag are placed in pairs with aisles on each side. The floors slope from the sides of the floor down towards the tables provided for the Speaker and the clerks. The rooms are lighted from the roof. The space between the inner and the outer glass roof

is warmed, so that no cold can strike downwards from the roof. The debating-rooms are surrounded on six sides by warm rooms or other premises. The two remaining outer walls are hollow-built and are warmed by means of circulating air (quite shut out from communication with the debating-room). The debating-rooms thus have no transmission of heat in any direction that could cause drafts in consequence of cold currents of air. The accompanying figures give a schematic representation of the arrangement and employment of the one or the other of the two systems of ventilation.

FIG. 1. UPWARD VENTILATION

The fresh, and, usually, warmed, air is driven upwards by a propulsion fan, from the lowest duct marked on the drawing, to a hot-air chamber lying above it. Above the hot-air chamber lies a regulating room where everything concerning the ventilation of the debating-room is

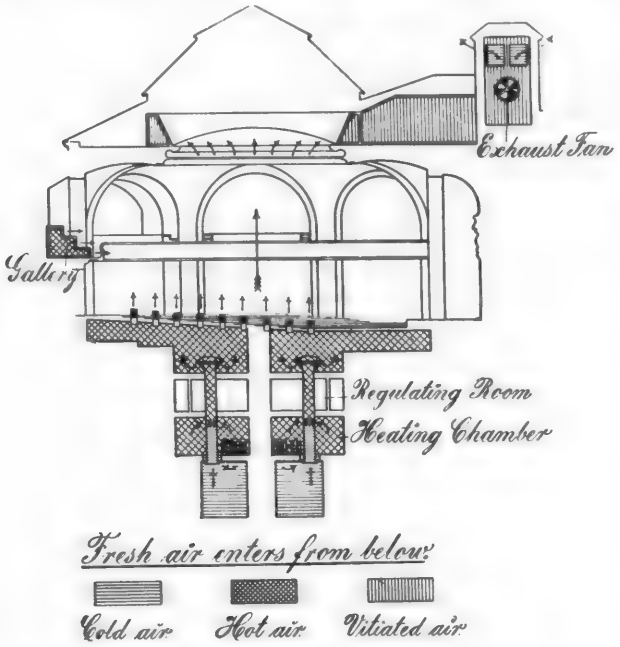


FIG. 1

controlled. Here the valves in four cylindrical air shafts proceeding from the hot-air chamber are so adjusted that the air enters the air-distributing chamber at the temperature and to the amount desired. This chamber lies immediately beneath the debating-room, and is of the same surface area as the area of the floor above. For each pair of chairs there is an air flue in the floor as shown in Fig. 2.

The flue is provided at the bottom with a valve which can be regulated or entirely closed, and in this way the ventilation can, to a certain degree, be regulated so as to suit the individual demands of each Member of the House. In order that the air shall stream into the room at the least possible speed, cast-iron gratings with exteriorly widening orifices are employed. Experiments have shown that the air streams out almost exactly equal over the whole surface of the grating, and that the jets of air from the individual openings unite again fairly well. Were the movement of the air quite homogeneous, the maximum speed at full ventilation would amount to but 0.25 meter = 10 inches per second. It is a specially favorable circumstance that, as we have already mentioned, the Members of the Riksdag sit in couples. This makes it possible to direct the stream of air to both sides outwards into the aisles between the rows of chairs.

The air current that actually exists, although it is but a very weak one, is, therefore, not directed forwards against the legs of those seated in the room, as is usually the case. As the gratings do not lie in the same plane as the floor, but are almost vertical and elevated above it, this does away with the usual objection, that the current of air blows the dust about.

The arrangement of the gratings has, most certainly, a great deal to do with the good results that have been obtained. The vitiated air is led off by way of the ceiling. The outlets for the air build a narrow opening along the entire ceiling circle and are only broken by the spaces needed for the beams carrying the ceiling. The vitiated air streams out into a practically circular duct and moves along this to an exhaust fan which forces the air out into the open. The speed, both of the electric exhaust fan and of the propulsion fan, can be controlled from the regulating room.

By means of a pneumometer, an instrument for measuring small differences of pressure, constructed by G. A. Schultze, of Berlin, it can be observed in the regulating room if there is more or less pressure in the debating-room than in the surrounding rooms, passages, etc. This exceedingly sensitive apparatus shows a difference of pressure measurable by 1/40 mm. of a water-column. With the assistance of this valuable instrument, it is easy to control the work of the two fans in respect to each other so that a very slight degree of higher pressure prevails in the debating-room than in the surrounding rooms. This is of especial importance as preventing drafts from the doors.

To the galleries air is led from below, although in a simpler manner than that adopted on the floor of the room.

The measuring instruments employed and observed in the regulating room are, in addition to the pneumometer already named, a static anemometer (air meter) in each of the four cylindrical main shafts and pneumatic long-distance thermometers that give the temperature in the debating-room and in the galleries, etc. The anemometers are made in the form of sensitive balances, one scale of which hangs in the air current and brings about a greater or less movement of the balance.

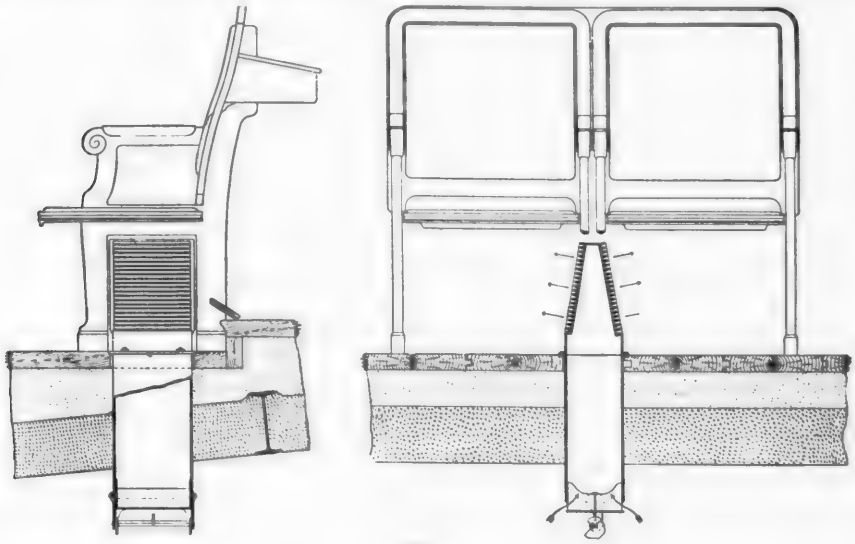


FIG. 2

FIG. 3. DOWNWARD VENTILATION

The fresh air enters, as in the former case, by means of the propulsion fan from the lowest duct marked on the drawing, but it is afterwards carried vertically upwards into a walled hot-air chamber beneath the roof. Its steam valve is controlled from the regulating room, but there are in addition two large mixing valves for cold and warm air, which valves are also controlled from the regulating room. The air, which is adjusted precisely by these valves, both as regards quantity and temperature, now enters the circular duct before mentioned that communicates with the debating-room by means of the narrow opening around the ceiling of the room. The outlet expands inwards towards the room in order that the speed of the air shall be reduced on its streaming in. The vitiated air is now taken through the same gratings beneath the seats which previously formed the inlets, and thence comes into the chamber beneath the room. From this chamber a vertical shaft, shown by dotted lines, leads up to the same exhaust fan that served for carrying off the vitiated air in the former case. From the different rows of the galleries the vitiated air is also carried off through the same openings that formerly allowed the fresh air to stream in, and the vitiated air is carried downwards to the same shaft that serves for the ground floor of the debating-room. In this system, too, special distance thermometers and anemometers and penumometers are also employed, so that both systems are equally complete in every respect.

When the debating-rooms were first occupied, the air in the one room was allowed to go upward, and in the other room downward, while nobody was informed that any difference in systems existed, or of the direction in which the air went. At first only short meetings

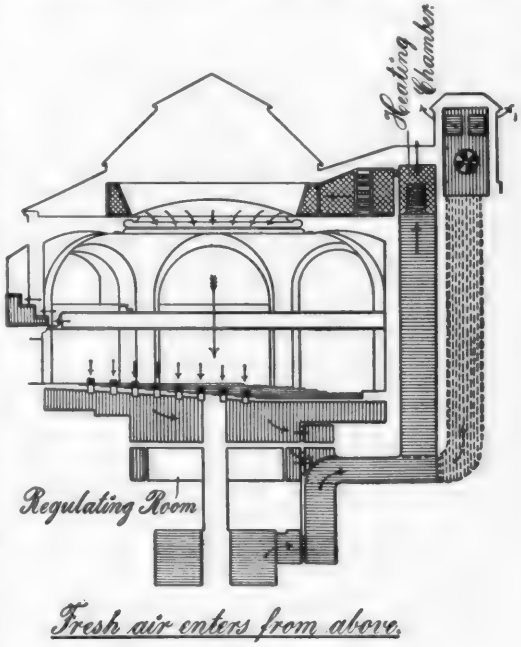


FIG. 3

were held, and it seemed as if the two systems could be used indifferently, no complaints being made. But things changed when long sessions lasting many hours began to be held. In the debating-room where, for the occasion, downward ventilation was being employed, a general uneasiness and complaints arose in consequence of the drafts. But when upward ventilation was employed, nothing was heard any more. This experience was gained both in the First and Second Chambers, although it was at different times that downward ventilation was employed in the one or the other room and without anyone being informed of the matter. The result was that in both debating-rooms all attempts to use downward ventilation were abandoned, so that at present nothing but upward ventilation is employed.

But the experience gained in the debating-rooms of the First and of the Second Chambers presents, however, decided differences. In the Second Chamber no inconvenience is experienced if the amount of ventilation originally intended, viz., 50 cubic meters = 1,750 cubic feet per person, per hour, be employed. But in the First Chamber the amount must not exceed 35 cubic meters = 1,225 cubic feet, otherwise complaints are heard about drafts and cold about the legs. It can, of course, happen that some one very sensitive person in either Chamber makes complaints, but then a way out of the difficulty is found by wholly or partially closing the ventilating valve beneath the complainer's chair. But with downward ventilation, complaints were general, i. e., they were heard from many persons. It is, of course, impossible to satisfy everybody, as personal opinions are so various, but it can be safely said, that with upward ventilation and the above-named ventilation amount in the two rooms, the ventilation gives general satisfaction. Should any complaints be heard, it is generally from the First Chamber at the close of a sitting lasting many hours; complaints are more seldom heard from the Second Chamber. The duration of a current of air has, of course, some influence too, in that, though it is not felt as an inconvenience when lasting but half an hour, can become very noticeable at the end of an hour and rather troublesome during the ensuing hour.

And, besides, it is not at all sure that the drafts felt come from the gratings beneath the seats. Great care must be taken with the ventilation of the galleries. If these be poorly occupied, the ventilation should be greatly restricted, for otherwise, in consequence of its lower temperature, the incoming mass of air will fall over the railings down upon the bald heads (mostly existing in the First Chamber). Should the galleries be well filled there is no danger of this, for then the air is warmed by the public, and rises towards the ceiling.

The conditions of the temperature during the winter session, January-May, have been very favorable. In the First Chamber the rise in temperature after a sitting of several hours' duration and with well-filled galleries, has, as a rule, been 1.50 degrees Cent. (2.7 degrees Fahr.). The fresh air has, during this period, been introduced at a temperature of 2.0 degrees Cent. (3.6 degrees Fahr.) higher than that of the room. The result given may cause astonishment, but can be explained by the fact that the air introduced is dry (humidifying apparatus exists but is not used), and that the room is large in proportion to the number of the Members. It is also common in our First Chamber that a great number of the Members do not put in an appearance during a sitting. This fact, again, necessitates a smaller quantity of air per place, and a higher degree of temperature for the in-streaming air in order to avoid drafts. The temperature in the galleries does not, as a rule, become higher than that of the floor of the House, even when the galleries are well filled. This is explained by their lesser distance from the large glass roof or ceiling, the warming of which from above is not carried up to the temperature of the room, and thus, in some degree, has a cooling effect.

During the summer session we had only one day of, what was for us, unusual warmth, viz., 27 degrees Cent. (80 degrees Fahr.). On this day the temperature in the fully filled galleries of both Chambers rose to 22.5 Cent. (72.5 degrees Fahr.). Otherwise the temperature kept within normal bounds. There is no air-cooling apparatus in use, but the capacious air-ducts (as large as ordinary corridors) and the many introductory chambers the air has to pass before it enters the debating-rooms serve sufficiently well for cooling surfaces.

The result of the comparison between the two systems is pretty remarkable. The writer of this article—the constructor of the heating and ventilation systems of the Riksdag's House—was positively convinced of the superior merits of the system of upward ventilation. But the German professor who, at the time, was called in to give his opinion on the matter, recommended the downward system. Fortunately we were able to insist on having both systems adopted and tried. But the downward system now constitutes, for the time being, at least, a closed chapter.

It may be mentioned finally, that the same results have been experienced at the German Reichstag's House in Berlin as those learned at Stockholm, and that the downward system has been replaced by the upward one.

Power Required to Thread, Twist and Split Wrought Iron and Mild Steel Pipe

By T. N. Thomson (Member of the Society)

T. N THOMSON

THE matter of threading pipes, although apparently a small detail in heating installations, is nevertheless a very important factor in the heating trade. It is the threads that hold the several parts of a heating system together, and it is the degree of perfection obtained in the cutting of threads that influences to a considerable extent the tightness of the innumerable joints in a heating system.

Few things are more tantalizing to the fitter than a number of leaky joints or splits developing in a system of piping that has been thoughtfully planned and has been erected with considerable care and a great deal of labor. So I feel that anything which can be done to obtain more perfect joints and fewer splits and that will reduce the amount of power required to make the joints is a matter worthy of consideration by this body.

Some time ago my attention was called, by the National Tube Company, to steps that are being taken by them along the line of inducing manufacturers of dies to make certain improvements in the form of dies that will enable the fitters to cut better threads with a smaller expenditure of energy than obtains at present with the ordinary forms of dies. Of course, it is human nature to suppose that the object of the pipe manufacturers in placing before the trade, free of charge, the results of their investigations, researches and experiments along this line is to further the interests of the pipe-making business, and no doubt it is. But this is no reason why so important a matter should not receive the careful consideration of the American Society of Heating and Ventilating Engineers, and most particularly those of you who are in the contracting business.

I have investigated the matter a little from an educational standpoint on behalf of the International Correspondence Schools of Scranton, with a view to imparting reliable instruction to our students, many of whom are located in out-of-the-way places, and even in foreign lands. Before commencing to investigate this matter I at once realized that in doing so I placed myself between the devil and the deep sea, so to speak. On one side of me are the pipe manufacturers and on the other side the consumers. The manufacturers discovered long ago that in order to supply the increasing demand for pipe in this country it was considered necessary to make use of the quite recent methods of producing weldable mild steel. By this process the pipes are made by the mile, so to speak, and are thus comparatively cheap and within the reach of all, rich and poor alike. No doubt this is one of the reasons why the steam-fitting trade has reached such gigantic proportions in the building trades. Probably from 60 to 80 per cent. of the pipe used in the United States to-day is steel pipe. Hence the necessity of the trade having tools designed to properly work this metal.

There are two kinds of steel pipe and two kinds of wrought-iron pipe on the market, namely, good wrought iron and poor wrought iron, good steel and poor steel, and you cannot ordinarily distinguish between them till after the goods are bought and the men are cutting and threading them on the job. Some will split, some will chip as if made of crystal, in some the threads will strip, while others may even break across like glass bars. What can you do with pipe like that? Do not pay for it; ship it back at once, and quit dealing with that concern. Perhaps you got a special price on that pipe? Well, quit special prices on carloads of questionable pipe. The margin of profit in heating contracts is too close to warrant any contractor in playing with cheap steel or iron pipe of unknown make. Old scrap iron and steel are good enough for use in the manufacture of other articles of commerce, but not in the manufacture of pipe. Many people who have had galling experiences with poor pipe may, without further thought, form a deadly relation between the improved form of die and the poor pipe. And it is true that the die will enable the fitter to thread pipes that would give him all manner of trouble with the ordinary form of dies, but at the same time it is a solid fact that progress in the manufacture of dies must not cease because there is poor pipe on the market and because the die question has been brought up by the pipe makers. The great fundamental fact is that the trade must have very good uniform dies and very good uniform pipe. If they cannot both be obtained at once, then let us get one at a time. It does not matter a great deal which one comes first, as long as the desired results are ultimately obtained. The die question is

the smaller one of the two, and probably is the one that would naturally come up first, any how. After the pipe-working tools are made perfect and the mechanics are trained to keep them in good condition, then the trade can, with a clear conscience, demand from the manufacturers a grade of uniformly good pipe that will withstand all the strains and stresses incident to the unavoidable rough usage, threading, bending and fitting-up operations. Then, and not till then, will this gnawing trouble of split pipe come to an end.

It was evident that a knowledge of the physical properties and general characteristics of both wrought-iron and mild-steel pipe was essential as a forerunner of an investigation into the dies. Therefore I made a tour of some of the largest pipe mills in America. I carefully followed the process of making the wrought-iron pipe from the puddling furnaces, and the steel pipe from the blast furnaces, all through the mills, to the shipping department. The rolling, welding, straightening, threading, testing and shipping processes are exactly the same for wrought iron as for steel pipe, the only difference being in the composition and properties of the two metals. To all external appearance they are the same. I had a number of ring tests made to show the peculiarities of the two metals and the relative strength of wrought iron and steel pipe. It was a noticeable fact that the wrought-iron rings broke very easily under the straightening-out process by which a combination of tensile and cross strains are developed. Fig. 1 shows at *(a)* how the test was applied. A ring of pipe about 1 inch to 1½ inches wide is secured by two hooks in a testing machine. The machine is set in operation and the hooks are pulled apart until the ring breaks, the pull applied to the ring by the machine being indicated by an electric measuring device. The rings tested were cut from lap-welded pipe; the welds in the tests were placed as at *(a)*, Fig. 1, so as to test out the weld with relation to the strength of the other parts of the pipe. The illustration shows at *(b)* how the mild-steel rings generally broke, and at *(c)* how the wrought-iron rings frequently broke. The tests developed the fact that some of the welds were stronger than the pipe, while others were weaker than the pipe. The strength of the weld depends a great deal upon the amount of the lap; those that did break at the weld were apparently short laps.

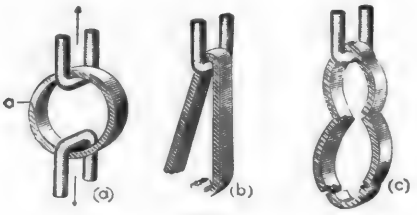


FIG. 1

Table No. 1 shows the result of some tests I had made on 8 rings of 6-inch pipe—four being wrought iron and four being mild steel. I made these principally to observe the ductility of the metals in pipe form and the fractures, but the results are nevertheless interesting:

TABLE I

RING TEST—LAP-WELD PIPE

Wrought Iron Actual Breaking Strength	Mild Steel Actual Breaking Strength
4,100 lbs.	5,300 lbs. Defective weld.
3,100 lbs	35,000 lbs.
3,000 lbs.	29,000 lbs.
2,400 lbs.	18,000 lbs. Hooks slipped.

Table No. 2 was made by the National Tube Company, and is more extensive than the above. It shows the tensile strength of the metal, the tensile strength of the seam, and the relative strength of the seams as compared with their respective pipes.

Perhaps the most important feature in this table, as far as we are concerned at the present moment, is the fact that the ratio of strength between seam and pipe varies considerably. The strongest iron seam is 84.26 per cent. the strength of the pipe; the weakest iron seam is 49.07 per cent. the strength of the pipe. The strongest steel seam is 92.96 per cent. the strength of the pipe, and the weakest steel seam is 50.30 per cent. the strength of the pipe. No doubt these were samples of good pipe. This table, therefore, serves to emphasize the fact that neither wrought-iron pipe nor steel pipe is uniform throughout in character and strength. It particularly shows how some pipes will split more easily than others while being worked.

The plumbing and heating trades experience a great deal of trouble with pipe; the seams frequently become split while the pipes are being threaded, and considerable loss of time and money is

TABLE 2.

WELD TESTS.

3-Inch Butt Weld Iron and Steel Pipe.

	METAL. Tensile Strength lbs. per sq. in. Transverse Section.	WELD. Tensile Strength lbs. per sq. in. Transverse Section.	Per cent. of Tensile Strength of Metal.
Iron	36,910	31,100	84.26
	35,280	23,650	67.04
	30,530	23,440	76.84
	32,870	16,130	49.07
	35,720	27,630	77.36
	34,400	25,620	74.48
	31,360	21,550	68.72
	37,700	26,440	70.14
	35,950	25,350	70.52
Average	34,520	24,540	70.93
Steel	62,000	46,420	74.86
	62,440	48,870	78.26
	60,860	44,890	73.76
	60,180	52,900	87.90
	62,180	41,380	66.54
	60,000	35,050	58.42
	67,000	62,280	92.96
	61,320	52,480	85.58
	60,660	30,510	50.30
Average	61,850	46,080	72.28

occasioned all around. The reason why the seams become split is because they are not as strong as the rest of the pipe. If they were as strong as the pipe, then it would appear that the pipe would either twist or tear when an excessive force tends to open the seams.

Most of the splits in the trade are produced, I believe, in threading butt-welded pipes. The lap-welded pipes evidently do not split so frequently. The teeth of the dies in cutting the thread at the butt weld seem to catch squarely against the weld as shown in Fig. 2, which exaggerates the thickness of the pipe, but clearly shows by arrows the direction of the principal forces that tend to split the pipe at the seam. The cutting face *a* of the die is radial; that is, it points toward the center of the pipe. The cutting edge, therefore, is a right angle. This kind of die, I understand, is to-day used more or less by nearly every firm in the heating business. I call this an imperfect design because it does not have an acute-angle cutting edge like any other cutting tool. All tool manufacturers know that there is a certain angle or rake that is best adapted for cutting different metals in the most easy and most perfect manner, but it seems that the die makers are very slow in methodically introducing this principle into the die business. Fig. 3 shows at *(a)* the tearing-out process of metal cutting by the imperfect dies in

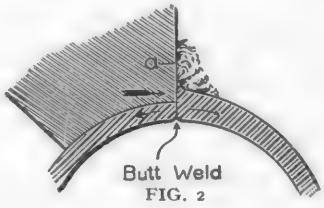


FIG. 2

common use, and at *(b)* the correct principle of cutting metal as it is recognized by expert metal workers. Suppose a a^1 to be plates of mild steel such as is commonly used in pipe manufacture; then, according to tests that have been made, the power required to pull the cutter b is about 60 per cent. more than that required to pull the cutter b^1; and if a relief is made on cutter b^1 as shown by dotted line c^1, the difference will be more near 100 per cent. If the plates were

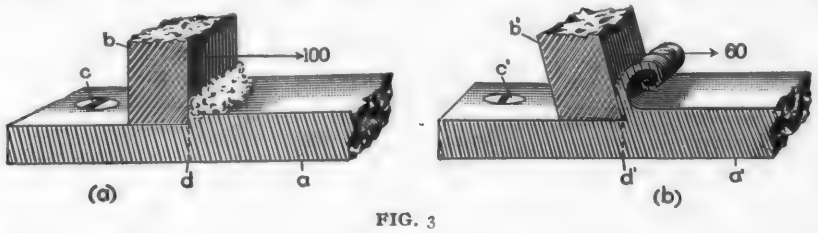


FIG. 3

made of wrought iron, the power required to pull *b* would be approximately 45 per cent. more than would be required to pull b^1. The ratio of the powers, of course, will vary with the composition and physical properties of the metals, but for ordinary wrought iron and mild steel, as they are found in pipe form, the aforesaid ratios, I believe, are approximately correct.

Suppose that the plates *a* and a^1 were bolted down tight at *c* c^1, and suppose that they had been made in two pieces with butt-welded seams as shown by dotted lines at *d* d^1; it will be easily seen that the tensile stress on the seam *d* is about 100 units, while the tensile stress on the seam d^1 is only about 60 units, the thickness of the plate and the depth of the cut being the same in both cases. It is therefore evident that the seam *d* will be more readily split than seam d^1, assuming that they are both welded with the same degree of perfection. And so it is with the butt-welded seams of both wrought-iron and mild-steel pipes; the square cutting edge of the old-fashioned die will split the seams of pipe that can be easily threaded with dies of the correct form.

A large number of experiments on different forms of dies, the cutting rake, etc., go to show that the best angle of rake for dies that are to be used only on wrought-iron pipes is about 12 degrees; the best angle of rake for dies to thread only mild-steel pipes is about 20 degrees, and the best angle for a die that is suitable for both wrought-iron and mild-steel pipes is about 17 degrees, as shown in Fig. 4, and it can be greatly improved by having the die cut with a relief, as shown by dotted line *a*, so that the die will bear on the pipe only at the cutting edge.

Fig. 5 shows how the power was measured for threading both wrought-iron and mild-steel pipe with both the square-edge die and the improved die. A test made on this machine with two samples of good pipe gave the results shown in Table III. The dies were both in good condition; it is from this trial that the preceding ratios are determined.

believe the above is a fair average for good pipe.

It shows that the power required to thread mild-steel pipe with the new die is not much more than that required to thread wrought-iron pipe with the same die, and much less than the power required to thread wrought-iron pipe with the common die.

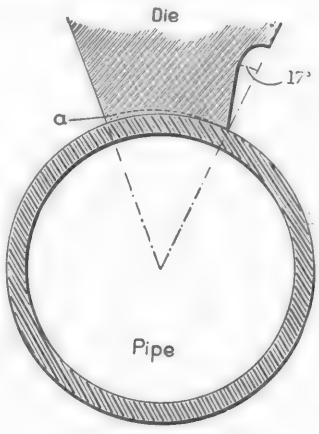


FIG. 4

This is an improvement in dies that makes the threading operation very easy on the men. If men are to be expected to do good work and keep it up, all needless expenditure of energy should be eliminated. I do not see the use of a fitter pulling 100 pounds on a stock arm if a pull of 60 pounds can be made to accomplish the same purpose. It seems a pity that a suggestion for the improvement of dies should come from the pipe mills, but it appears that they have made the greatest investigations and experiments and have given the matter more study and thought than any other party, and they consequently are entitled to the floor. An objection may be raised to the effect that if a pipe is so poor that it will split while being threaded, it has no right to be installed as part of a heating or power system. This objection is strictly correct, but it is no reason why we should depend on testing pipe for splitting proclivities by cutting threads

TABLE III

KIND OF PIPE	OLD FORM OF DIE Pull in Pounds on a 21-inch Lever	NEW FORM OF DIE Pull in Pounds on a 21-inch Lever
1¼-inch wrought iron	83 to 87 lbs. pull	58 to 62 lbs.
1¼-inch mild steel	100 to 111 lbs. pull	60 to 65 lbs.

The samples used in the above test were ordinary good quality pipe picked out at random. A series of tests along this line would no doubt develop somewhat different results, according to the kind and hardness of the material, but I

on them. The fact of the matter is that all the pipes should be tested at the mills, and all imperfect pipes should be cut up and sent to the scrap pile. A number of the large mills test all the pipe that is shipped, every pipe-threading machine

being equipped with a corresponding measuring and testing machine and a trained crew, but I do not know whether all pipe mills are thus equipped.

To depend on the threading process for testing pipe seams is, in my estimation, absolute foolishness, for a large amount of pipe is fitted up in every job that is never subjected to the twisting strain produced by threading. For example, a number of full lengths constitute part of the mains; they are threaded in machines at the pipe mills by properly made dies. The risers are constituted principally of pipes that have a short piece cut off one end, and the end threaded. The only piece that has been subject to twist is the short part that came between the vise and the die. The remainder of the length has had no twist except a little at the other end that may be applied by the "Stillson" in screwing up the pipe.

Of course, it is advisable to take all precautions to prevent poor pipe from getting into a heating or power system, but it seems to me that better results will be obtained by an intelligent inspection of the seams and by a series of torsion tests that will actually test the strength of the welds the full length of the pipes. Of course, the right place to have pipes tested is the place where they are made. It therefore seems to me that torsion tests should be applied at the mills. Probably the present hydraulic testing machines can be slightly changed so that each pipe while being tested with water pressure will in the same operation be subjected to a certain amount of twist that will immediately prove whether the pipe is watertight and whether it will split in being handled by the trade.

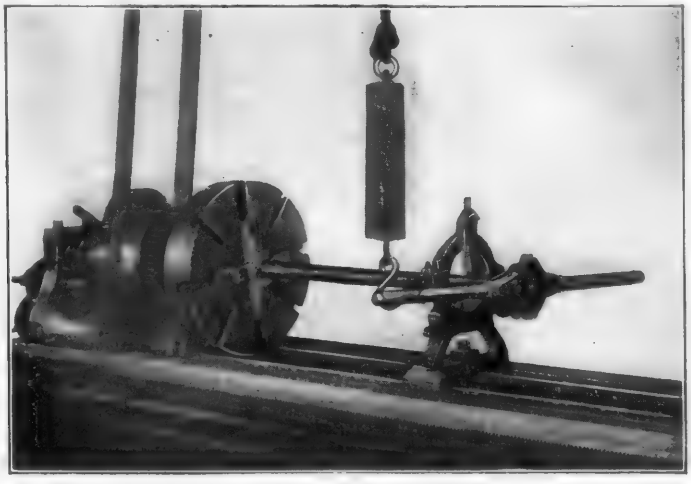


FIG. 5

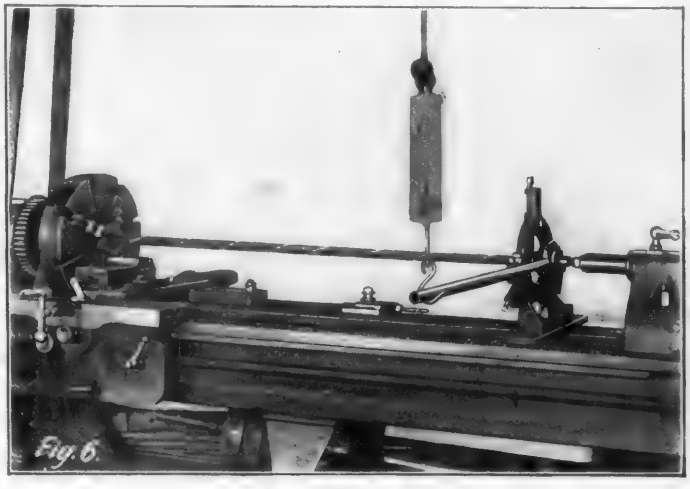
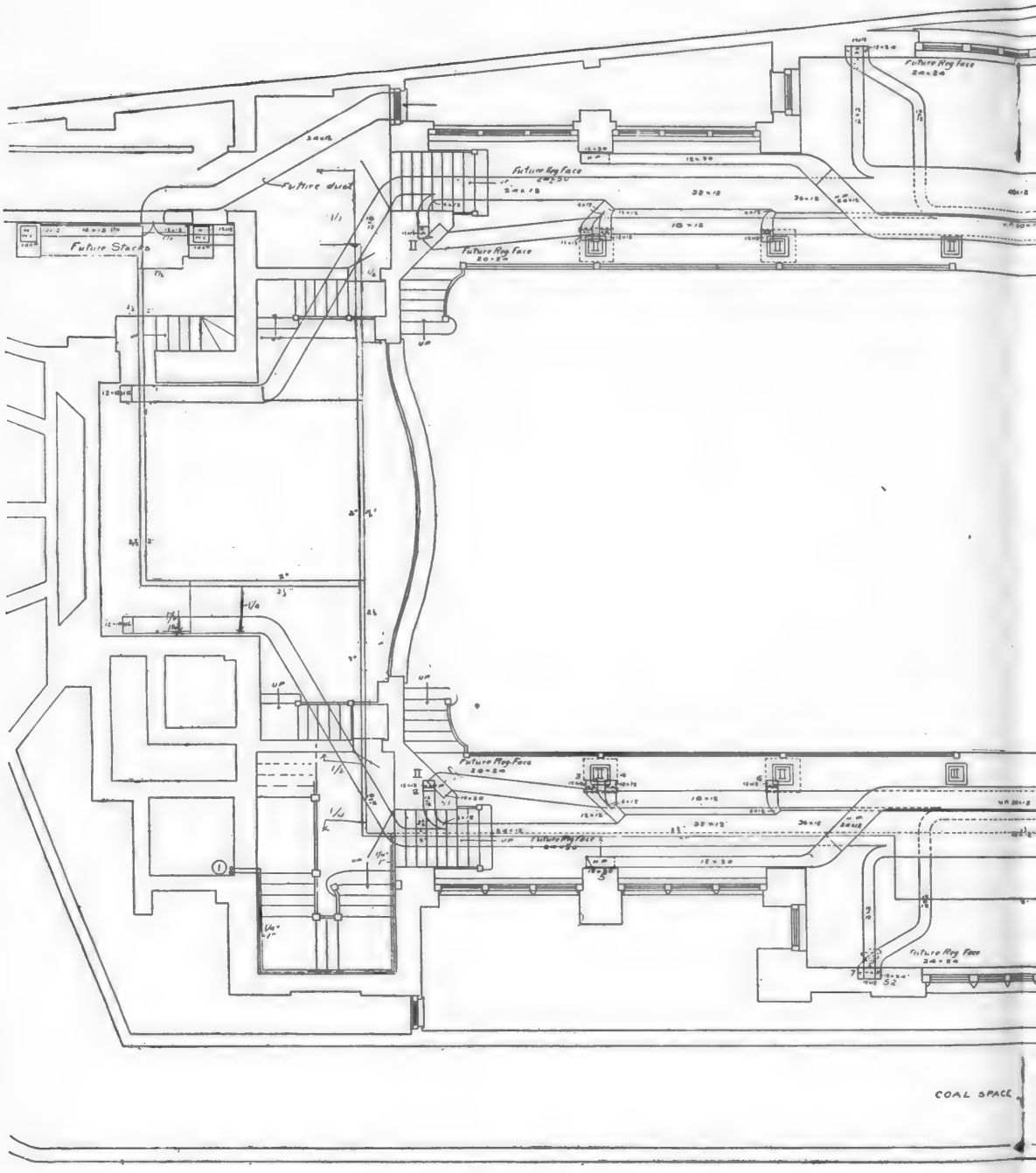
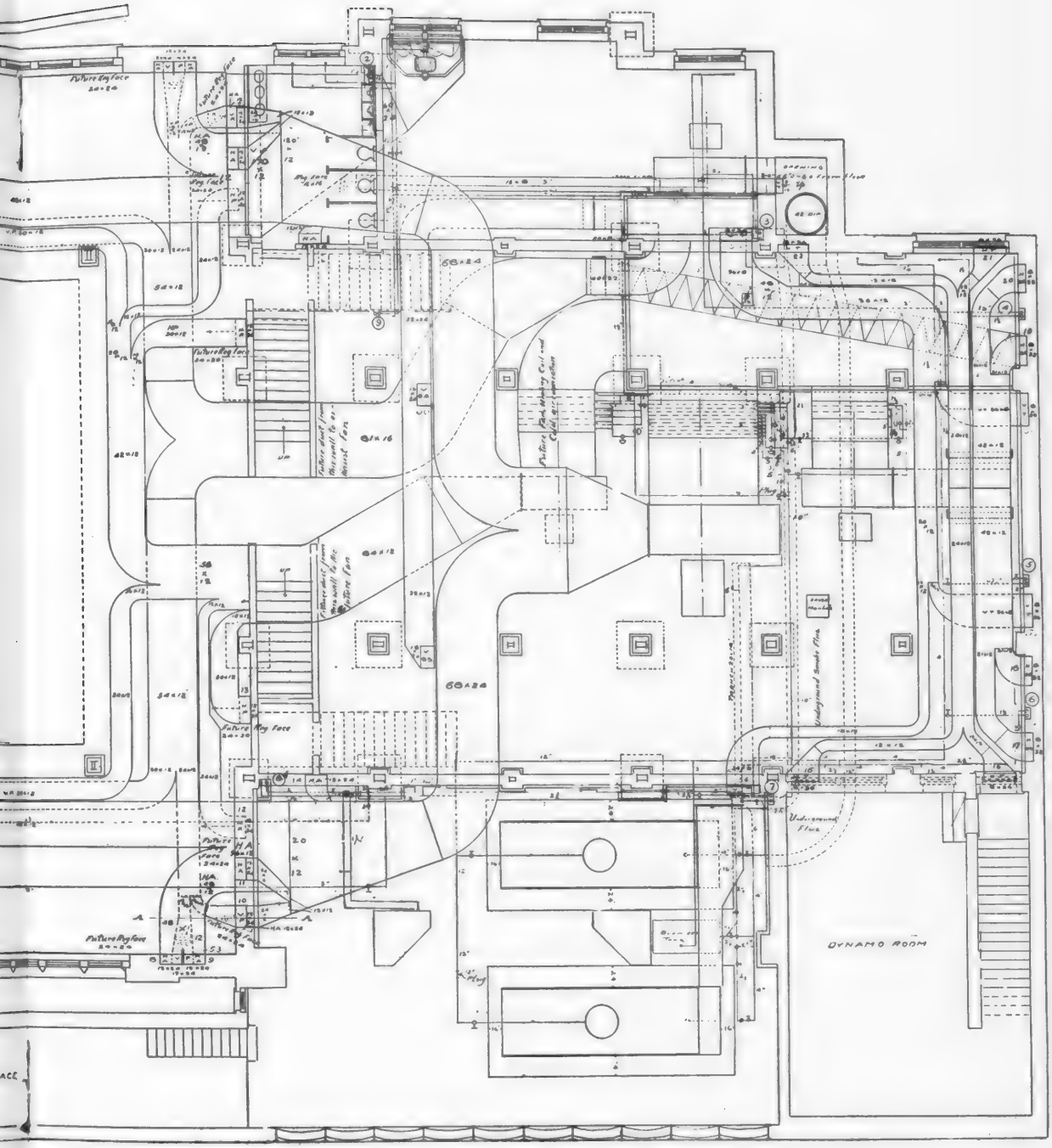


FIG. 6

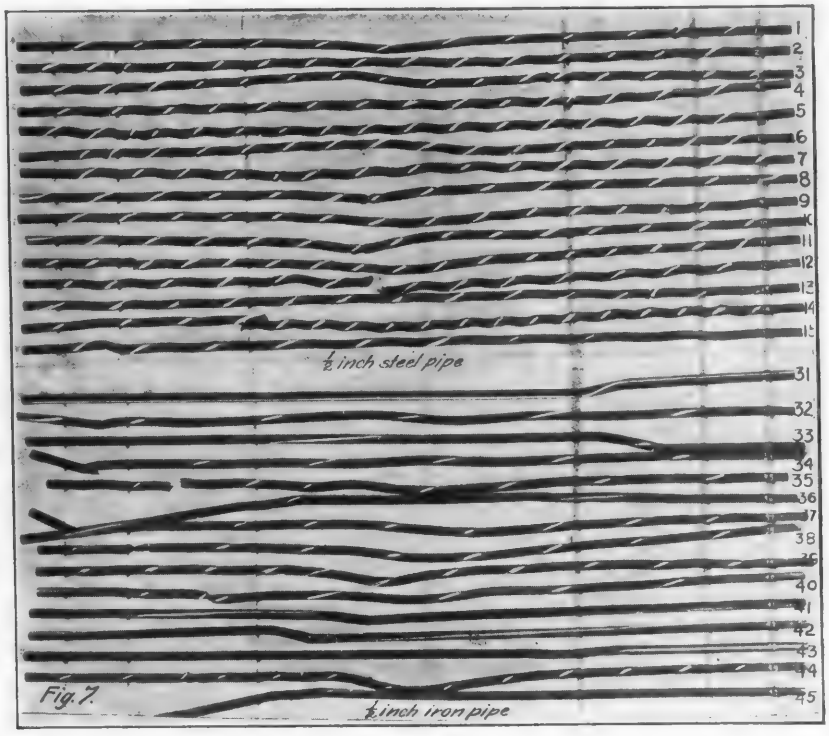
To secure some definite information regarding the power required to split or twist pipe, a number of torsion tests were very kindly made by the National Tube



HEATING AND VENTILATING THE MAIN AUDITORIUM OF THE BROADW
Plan also Shows Arrangements for Heating a



ROADWAY TABERNACLE.—PLAN OF BASEMENT SHOWING LAYOUT OF SYSTEM
leating and Ventilating Other Portions of the Building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½ inch steel pipe
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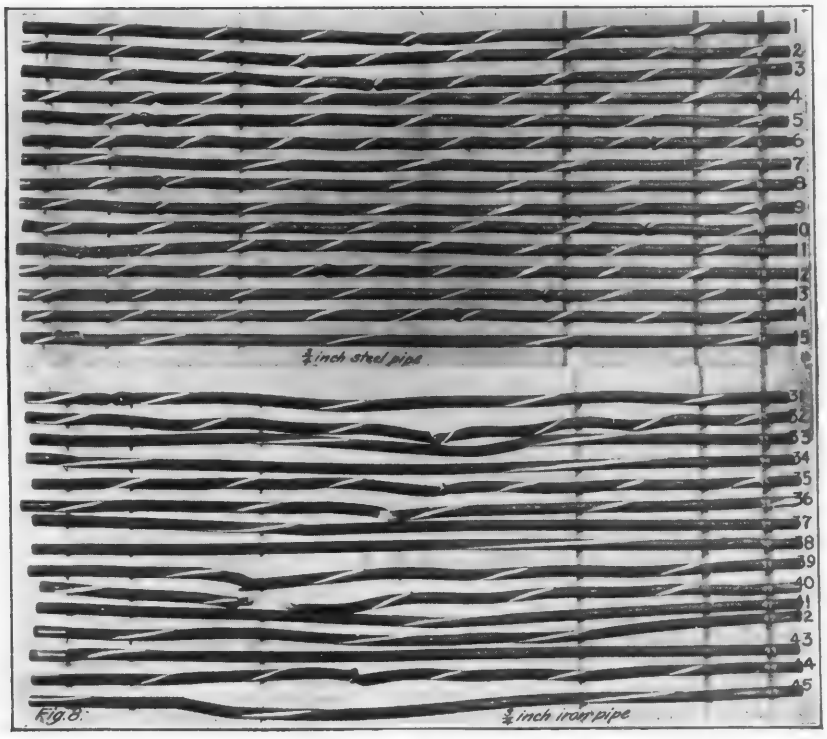
Fig. 7.
½ inch iron pipe

FIG. 7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¾ inch steel pipe
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Fig. 8.
¾ inch iron pipe

FIG. 8

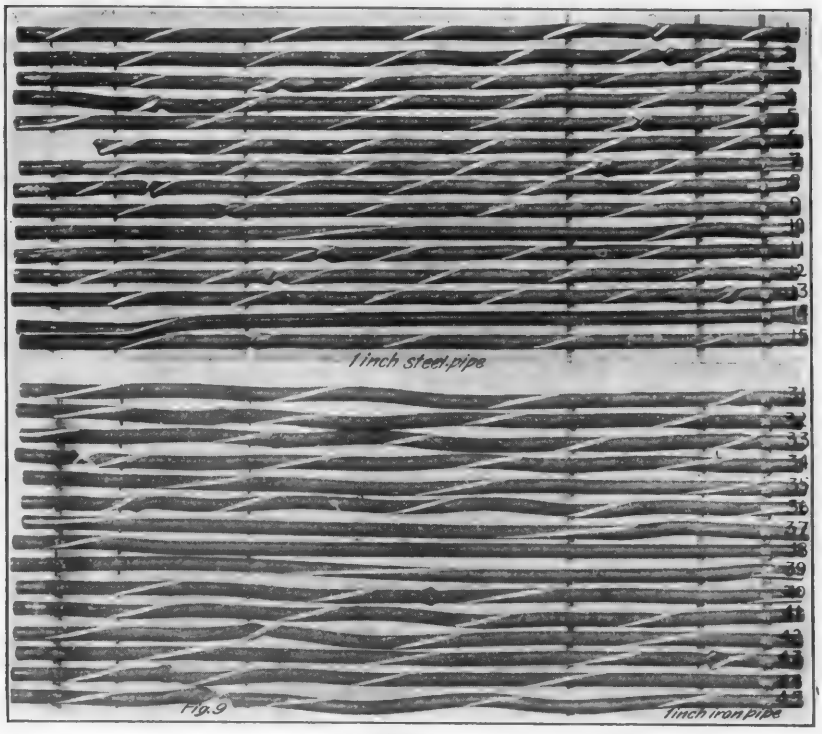

FIG. 9

Company. The sizes twisted were ½-inch, ¾-inch and 1-inch. The pipes were selected at random. I purchased a lot of common merchant pipe on the open market by cutting a piece out of a length in different bundles. No two pieces were taken from the same length nor from the same bundle. In this way I believe we obtained a fair average. Each sample to be twisted was 6 feet long. Fig. 6 shows the machine used to make the test. One end of the pipe was secured to the chuck of a lathe, the other was secured to a clamp having a 3-foot lever, which was held up by a spring balance as shown. The machine was put in motion, and the power required to twist the pipes or split them was recorded on the spring balance and noted. Each piece of pipe was subject to precisely the same conditions. The results of the tests were tabulated in detail, and are altogether too voluminous to be incorporated in this paper. Figs. 7, 8 and 9, however, are a few of them, and will be sufficient to show how steel and wrought-iron pipes behave under excessive torsional stresses:

Table No. 3 is simply a summary of a

TABLE 3.

(N. T. Co.)

TWISTING TESTS ON BUTT-WELDED PIPE.—SUMMARY.

Size.	Material.	Wt. per ft. Lbs.	Variation from card wt. Per Cent.	Maximum pull on 3-foot lever lbs.			No. of Turns in 6 feet.	Per Cent. failed in weld.
				Low.	High.	Average.		
½ inch	Steel	.816	−2.2	90	120	109	15	0
"	Iron	.803	−4.2	40	98	68½	4½	73
"	Iron	.792	−5.2	20	113	81	5¼	66
"	Iron	.842	×0.6	50	85	65	2½	100
¾ inch	Steel	1.082	−2.9	160	185	172	8	13
"	Iron	1.097	−1.6	140	160	154	6.2	33
"	Iron	1.127	×1.0	80	176	136	3½	66
"	Iron	1.104	−1.0	50	160	107	2½	90
1 inch	Steel	1.658	−0.7	180	340	300	5½	13
"	Iron	1.593	−4.4	220	292	256	4½	46
"	Iron	1.616	−3.1	170	300	250	3½	33
"	Iron	1.620	−2.8	100	320	258	2½	66

large number of detail tables. In making up the latter tables the record of every piece of pipe is noted separately. The following tables apply only to the pipes shown in Figs. 7, 8 and 9. As the photos of the twisted pipes are too numerous to be all presented in this paper, I have selected the steel samples and the middle iron samples of each size. It would not be fair to put up the last line of samples of iron pipe against the steel photos, because this iron pipe was very poorly welded, as can be seen by Table 3, and a false impression of wrought-iron pipe may be formed. The middle sample is the product of a well-known maker and is known to be good wrought-iron pipe. Therefore Figs. 7, 8 and 9 show results of twisting tests on good steel pipe and good wrought-iron pipe, and the data for these tests are given in detail in Tables 4, 5 and 6.

The tests of the National Tube Company, I am satisfied, are very thorough and are exceedingly valuable records, but as they were all made on machines, and as ½-inch, ¾-inch and 1-inch pipes are threaded by hand in pipe vises, I made a number of tests at the laboratory of the International Correspondence Schools, with a view of obtaining as nearly as possible the strains that are actually placed on pipes in practice. We secured a number of samples from different supply houses and from the pipe racks in the plumbers' and fitters' shops in Scranton, the idea being to test the regular nondescript merchant pipe in common use and find how much power is actually required to thread and split this class of pipe by the mechanics on the jobs. To make the threads, we borrowed the tools from the trade, so that there also we would get actual practical results. In making the tests we used a pipe vise and Stillson wrenches, so that the action of their teeth and the shifting of grips would all form a part of the tests. Of course, it must be expected that tests made this way will develop entirely different results from tests made in machines with properly designed clamps and a steady application of the power. While the International Correspondence

TABLE 4.

(N. T. Co.)

FOR PIPES SHOWN IN FIG. 7.

½-Inch Steel.

Number of Pcs.	Weight pr. pce. Lbs.	Length. Ft.	Weight pr. ft.	Variation from card. Wt. p.c.	Max. Pull on 3 ft. Lever lbs.	Turns.	Remarks.
1.....	4.81	6.00	.801	— 4.3	105	12¼	Did not break.
2.....	4.81	6.00	.801	— 4.3	110	15	" " "
3.....	5.00	6.00	.833	— .5	115	16	" " "
4.....	4.75	6.00	.791	— 5.5	105	15½	Broke off.
5.....	5.06	6.00	.843	× .7	110	15½	Did not break.
6.....	4.88	6.00	.813	— 2.9	115	16½	" " "
7.....	4.75	6.00	.791	— 5.5	110	14¾	" " "
8.....	4.88	6.00	.813	— 2.9	110	13¾	" " "
9.....	5.00	6.00	.833	— .5	110	15	Broke off.
10.....	4.75	6.00	.791	— 5.5	100	14¾	Did not break.
11.....	4.88	6.00	.813	— 2.9	115	18½	Broke off.
12.....	5.06	6.00	.843	× .7	90	14	" "
13.....	4.81	6.00	.801	— 4.3	110	13¾	Did not break.
14.....	5.00	6.00	.833	— .5	120	20½	Broke off.
15.....	5.06	6.00	.843	× .7	105	9	" "
Average..	.....	.....	.816	.....	109	15	

½-Inch Iron.

31.....	4.75	6.00	.791	— 5.5	33	¼	Failed in weld.
32.....	4.88	6.01	.810	— 3.2	90	9¼	Twisted off.
33.....	4.69	6.00	.781	— 6.6	67	2	Failed in weld.
34.....	4.81	6.00	.801	— 4.3	113	6	" " "
35.....	5.12	6.01	.852	× 1.8	105	10	" " "
36.....	4.81	6.01	.800	— 4.4	73	3	" " "
37.....	4.50	6.02	.747	— 10.8	113	0	Broke off.
38.....	5.00	6.00	.833	— .5	100	9½	" "
39.....	4.63	6.00	.771	— 7.9	90	11	" "
40.....	4.88	6.00	.813	— 2.9	95	¾	" "
41.....	4.63	6.00	.771	— 7.9	73	2	Failed in weld.
42.....	4.69	6.01	.780	— 6.7	55	1½	" "
43.....	4.69	6.00	.781	— 6.6	20	¾	" "
44.....	4.75	6.01	.790	— 5.6	100	13	" "
45.....	4.63	6.01	.770	— 8.0	87	2	" "
Average..	.....	.....	.792	— 5.2	81	5¾	

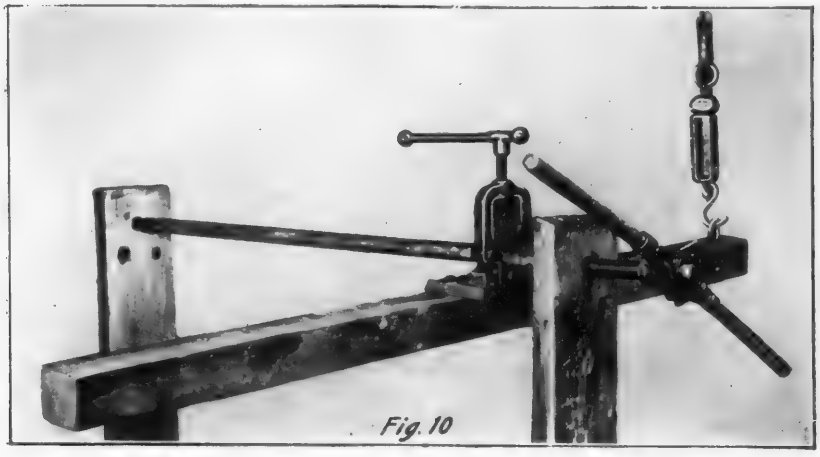

FIG. 10

TABLE 5.

(N. T. Co.)

FOR PIPES SHOWN IN FIG. 8.

¼-Inch Steel.

Number of pcs.	Weight pr. pce. Lbs.	Length. Ft.	Weight pr. ft.	Variation from card. Wt. p. c.	Max. Pull on 3 ft. Lever lbs.	Turns.	Remarks.
1	6.38	6.00	1.063	− 4.6	170	7¼	Did not break.
2	6.50	6.00	1.083	− 2.7	178	8¼	" " "
3	6.56	6.00	1.093	− 1.9	170	8¼	" " "
4	6.50	6.00	1.083	− 2.7	178	8¼	" " "
5	6.56	6.00	1.093	− 1.9	170	7	" " "
6	6.50	6.00	1.083	− 2.7	180	9¾	" " " [end.
7	6.44	6.00	1.073	− 3.8	160	5	Broke off under clamp at
8	6.38	6.00	1.063	− 4.6	165	7¼	Did not break.
9	6.31	6.00	1.052	− 5.6	165	6¼	" " "
10	6.50	6.00	1.063	− 4.6	175	7¼	" " "
11	6.75	6.00	1.125	× .9	180	8¼	" " "
12	6.68	6.00	1.113	.....	185	9¼	" " "
13	6.38	6.00	1.063	− 4.6	170	7¼	" " "
14	6.50	6.00	1.083	− 2.7	180	9¼	" " "
15	6.56	6.00	1.093	− 1.9	160	4¼	Failed in weld.
Average	.....	.....	1.032	− 2.9	172	8	

¾-Inch Iron.

31	6.75	6.01	1.124	× 0.8	150	2	Failed in weld.
32	6.88	6.01	1.145	× 1.8	176	7	Broke off.
33	7.00	6.00	1.167	× 4.7	140	3	Failed in weld.
34	7.12	6.00	1.187	× 6.5	120	2	Broke off.
35	7.00	6.01	1.165	× 4.5	160	7	Did not break.
36	7.00	6.00	1.167	× 4.7	140	4½	Failed in weld.
37	6.12	6.00	1.020	− 8.5	100	1	" " "
38	6.56	6.00	1.093	− 2.0	80	1½	" " "
39	6.88	6.01	1.145	× 2.7	140	4½	" " "
40	6.68	6.00	1.113	.....	120	1	" " "
41	6.44	6.00	1.073	− 3.8	100	1	" " "
42	6.88	6.00	1.147	× 2.9	140	3½	" " "
43	6.50	5.99	1 084	− 3.8	170	6	Broke off.
44	6.94	6.00	1.157	× 2.8	165	7	Did not break.
45	6.68	6.00	1.113	.....	140	2½	Failed in weld.
Average	.....	.....	1.127	× 1.0	136	3½	

Schools tests give an idea of what takes place at the pipe vise with hand tools, the National Tube Company tests show what may be expected at the threading machine.

Fig. 10 shows how we rigged up the apparatus. Two rigid 2-inch by 8-inch uprights each have three holes bored through as shown, one being for 1-inch pipe, one for ¾-inch pipe, and the other for ½-inch pipe. The pipe in all cases was grasped by a vise which was bolted to the center of a 4-inch by 4-inch timber. The pipe was lubricated where it passed through the uprights. As the arms of the stocks were 18 inches long from the center of the die to the extreme end, and as the actual distance of the center of a man's hand will be about 2 inches from the end of the stock arm, we attached an eyebolt to the 4-inch by 4-inch timber, so that the hook of the spring balance would be 16 inches from the center of the pipe in the vise. In this way we can read on the spring balance the amount of pull a fitter has to apply to the dies. For convenience, the power required to twist and split is also given with the balance at a 16-inch lever.

The difference between the threading operation which is shown in Fig. 10 and the twisting operation is that in the latter the dies were removed, Stillson wrenches were applied to the other end of the pipe where it passes through the upright, and the pipe was twisted by these wrenches. Of course, the wrenches chewed into the pipe and so did the vise, but this is a true condition of the trade, and it is well for us to know what happens under such conditions.

In reading the spring balance we noticed great variations, and it was rather difficult at times to obtain a definite reading. The records were all taken during steady pulling. When the dies were pulled quickly in jerks, or run dry, the power increased anywhere from 30 per cent. to 50 per cent. The old, common form of dies referred to was in very fair condition, the 1-inch die being particularly good. It did not cut down to gauge, and its record consequently is rather low. The results of the tests are

TABLE 6.

(N. T. Co.)

FOR PIPES SHOWN IN FIG. 9.

1-Inch Steel.

Number of pcs.	Weight per pce. Lbs.	Length. Ft.	Weight pr. ft.	Variation from card. Wt. p. c.	Max. pull on 3 ft. Lever lbs.	Turns.	Remarks.
1	10.0	6.00	1.667	.....	340	6	Did not break.
2	10.12	6.00	1.687	× 1.1	300	6¼	" " "
3	9.94	6.00	1.657	− 0.7	320	7¼	" " "
4	10.00	6.00	1.667	.....	260	5	" " "
5	9.81	6.00	1.635	− 2.0	310	5½	" " "
6	10.12	6.00	1.687	× 1.1	340	6½	Broke off.
7	9.94	6.00	1.657	− 0.7	320	6¾	Did not break.
8	9.88	6.00	1.647	− 1.3	330	5	" " "
9	9.94	6.00	1.657	− 0.7	320	6	" " "
10	9.88	6.00	1.647	− 1.3	220	2½	Failed in weld.
11	9.94	6.00	1.657	− 0.7	320	6	Did not break.
12	10.12	6.00	1.687	× 1.1	330	6	" " "
13	9.94	6.00	1.657	− 0.7	300	6	" " "
14	9.81	6.00	1.635	− 2.0	180	1	Failed in weld.
15	9.81	6.00	1.635	− 2.0	300	5	Did not break.
Average..	.....	.....	1.658	− 0.7	300	5½	

1-Inch Iron.

31	9.25	6.00	1.540	− 7.7	240	3½	Nearly twisted off.
32	9.50	6.02	1.580	− 5.2	260	4	" " "
33	10.00	6.00	1.667	.... .	280	4	" " "
34	10.12	6.02	1.680	× 0.7	300	4	Twisted off.
35	9.44	6.00	1.573	− 5.7	240	2½	Failed in weld.
36	9.63	6.02	1.600	− 4.1	270	4½	Nearly twisted off.
37	9.75	6.02	1.620	− 2.9	220	1½	Failed in weld.
38	10.06	6.02	1.671	.....	170	1	" " "
39	10.38	6.04	1.718	× 2.6	220	1½	" " "
40	9.25	6.03	1.531	− 8.2	240	4	Commenced to twist off.
41	10.12	6.04	1.678	× 0.6	280	4	Failed in weld.
42	9.44	6.02	1.566	− 6.1	256	3	Commenced to twist off.
43	9.68	6.00	1.613	− 3.3	260	3½	" " " "
44	9.56	6.01	1.590	− 4.7	260	4	" " " "
45	9.75	6.01	1.620	− 2.9	260	4	Twisted off.
Average.	.....	....	1.616	− 3.1	250	3⅘	

TABLE 7—(I C. S.)

PIPE TESTS. (Test pieces, 6 feet long; lever arm, 16 inches.)

Wrought Iron Pipe.

Dec. 5, 1905.

Size and number of samples.		Power to thread with rake die 16 in. lever. Lbs.	Power to thread with new square edge die. Lbs.	Power to thread with poor square edge die. Lbs.	Power to twist or split. Lbs.	Remarks.
¼ in.	1	25	30	45	100	Split at seam.
	2	25	30	45	110-140	Started to twist; went 2 times (Max., 180 lbs.); no split.
	3	30	36	50	100-140	Two turns; no split.
	4	28	35	48	100-120	2¼ turns; split at 120 lbs.
	5	27	35	58	100-140	1¾ turns; no split.
	6	25	30	50	105-120	One turn; split at 120 lbs.
½ in.	1	50	55	70	140	Split at stillson; no twist.
	2	42	50	72	140-200	¼ turn; split at vise.
	3	45	52	76	160-210	One turn; no split.
	4	43	50	75	150-200	¼ turn; split at stillson.
	5	40	46	70	140-200	¼ turn; split at stillson.
	6	50	55	70	150-180	Split at vise and broke off.
1 in.	1	60	100	115	280-360	Split at ¼ turn.
	2	55	110	120	270-330	Split; did not twist.
	3	65	105	120	280	Split at once.
	4	60	110	122	270-330	Split; did not twist.
	5	65	115	120	260-300	Split; did not twist.
	6	70	105	123	280-360	Split; did not twist.

Mild Steel Pipe.

Dec. 5, 1905.

¼ in.	1	50	60	65	180	1¼ turns; split at end with stillson.
	2	40	60	63	100-200	Twisted 2 times; no split.
	3*	30	36	48	100	Split at 100 lbs.
	4	38	55	58	110-125	Split at 125 lbs.
	5	30	50	56	100-125	Twisted one turn; no split.
½ in.	1	45	60	100	150-240	1 turn at 220 with no split; 2d twist split at 240 at vise and stillson.
	2	45	60	88	130-210	1 turn; no split.
	3	42	57	85	150-220	1 turn; no split.
	4	45	65	90	170-240	¼ turn; no split.
	5*	32	47	75	140-215	Split at ¼ turn at 215 lbs.
	6*	43	55	80	100	Split at vise ¼ turn.
1 in.	1	72	130	160	280-440	¼ turn; no split.
	2	70	100	120	280-400	¼ turn; flattened and split at stillson.
	3	62	105	140	350-440	Opened at stillson and vise; OK. at 400 lbs. 1 turn.
	4*	60	95	110	270-410	¼ turn; no split.
	5	80	110	100	240-360	Twisted ¼ turn; no split.
	6	00	110	100	280-400	¼ turn; no split.

* Galvanized wrought iron.

TABLE 8—(I. C. S.)

APPROXIMATE POWER REQUIRED (POUNDS) TO THREAD, TWIST AND SPLIT PIPE. SUMMARY.

Kind of pipe.	To Thread; well oiled; steady pull at 16 inch leverage on die-stock arm.			To Twist.	To Split.	Margin of safety. Lbs.
	New rake dies. Lbs.	New common dies. Lbs.	Old common dies. Lbs.	Steady pull with stillson's. Lbs.	Steady pull with stillson's. Lbs.	
½ inch Steel (4 samples)...	34.5	56.25	60.5	122.5	152.5	73.85
½ inch Iron (7 samples)....	27.14	33.14	49.14	102.14	110.	46.12
¾ inch Steel (4 samples)....	44.25	60.5	90.75	150.	240.	122.05
¾ inch Iron (8 samples)....	44.375	51.25	73.5	140.	176.43	80.88
1 inch Steel (5 samples)....	68.8	111.	124.	286.	420.	258.8
1 inch Iron (7 samples)....	62.14	105.7	118.57	272.85	326.66	172.52

given in detail in Table 7 and a summary is given in Table 8.

The margin of safety column at the right-hand side of Table 8 is compiled by adding 30 per cent. to the power required to thread with old dies and subtracting the sum from the power required to split the pipe. If the mechanic pulls on the dies beyond that limit, due to dull and imperfect dies or due to a hard spot in the pipe, he certainly will, according to the nature of things, split the pipe. Or if the power required to split is nearly the same as the power required to thread, as is the case in the last sample of ¾-inch pipe in the mild-steel list (which, on test, proved to be ¾-inch galvanized iron), then the pipe will certainly split, through no fault of the mechanic, but through defective tools combined with a quick, jerky motion which the men must put on the dies if they are going to hustle along the work. With dies having the proper rake there would be no danger of splitting this pipe while threading it. Fig. 11 shows the wrought-iron pipes after the International Correspondence Schools test, the steel samples being shown in Fig. 12.

In making the torsion tests we had to screw up the vise tightly to prevent the pipe turning, and this tended to crush the pipe and start the seam. The effect of gripping so tightly was quite noticeable, for most of the splits started at the vise. The galvanized pipes were more difficult to hold than the black iron because the galvanizing coat filled the teeth of the vise and somewhat prevented their gripping properly into the solid metal. In some of the samples we had to apply a Stillson to help the vise, allowing the arm of the Stillson to rest on the 4-inch by 4-inch timber to which the spring balance was hooked. In spite of the fact that the crushing effect of the vise and Stillson was much greater on the steel pipe than on the wrought-iron pipe, and the steel pipe seams were consequently much more weakened by the application of these tools, still it is noticeable that more power was required to split the steel pipe than the wrought-iron pipe.

It is also noticeable that the margin of safety for the steel pipe is much greater than that for the wrought-iron pipe, and it seems rational to assume that the trade must experience trouble by wrought-iron pipe splitting at the vise as well as steel pipe. Judging by the tests, it is evident that common steel merchant pipe will ordinarily twist before it splits, and that common wrought-iron merchant pipe will sometimes do the same thing, but the iron will not twist as much as the steel and requires on an average less power both to split and twist. However, in wrought iron this weakness is somewhat compensated for by the smaller amount of power required to thread.

It will also be noticed that by the use of old square-edge dies, particularly if the dies are very dull, it must be expected that both wrought-iron and mild-steel pipes will be occasionally split through no fault of the mechanic. It is also noticeable that the rake dies, even if run dry and in quick jerks, will keep well within the safety limit for common merchant pipe and should prevent split pipes.

My opinion of the entire case, independent of all outside influences, is that correctly made dies are a step in the right direction and that die makers should make all their dies with a rake that is best adapted for threading both wrought-iron and mild-steel pipes, and with sufficient relief to reduce friction. To offset this, as an inducement for manufacturers to ease up in their inspection, testing, and culling out of the poor pipe at the mills; I would suggest for your consideration the preparation of a standard torsional test that any intelligent mechanic can easily and quickly apply on a job to any length of butt-welded pipe, with the object of determining whether or not the weld is sufficiently strong to warrant its use in a building. I do not see why this cannot be done without materially increasing the cost of a piping system.

The perfection of the weld in any length of pipe, as I understand the matter, depends almost entirely upon the care, precision and alertness of the man who operates the welding furnace. If he is not competent or is neglectful of his duty, whole carloads of poorly welded pipe may get on the market unless, of course, pipe manufacturers apply torsion tests. As I see the matter at present, I believe the correct way to get the most accurate results, as far as the weld is concerned, is for the pipe manufacturers to scheme up some way of applying what may be called a hydro-torsion test.

It appears to me that the solution of the split-pipe trouble is a kind of family affair on the co-operative plan, in which pipe manufacturers, die manufacturers, and the masters and journeymen of the plumbing and heating trades are all concerned. To ensure a complete success, the duties of the co-operators may be as follows:

The pipe makers must all test their pipe, not only for leakage but also for strength of seam to resist splitting during threading and bending operations. The die makers must all fall in line and make the future dies with a correct rake and relief, so that the mechanics will not have to wear themselves out pulling 100 pounds when a 50 or 60 pound pull will do the work, and particularly when properly formed dies will wear better and longer than square-edge dies. The master plumbers and fitters must all get their old dies fixed up or get new ones of the

correct form, and keep them fixed up. And the journeymen have their share of the responsibility also, in that they must see that good dies receive good usage and are liberally fed with good lard oil.

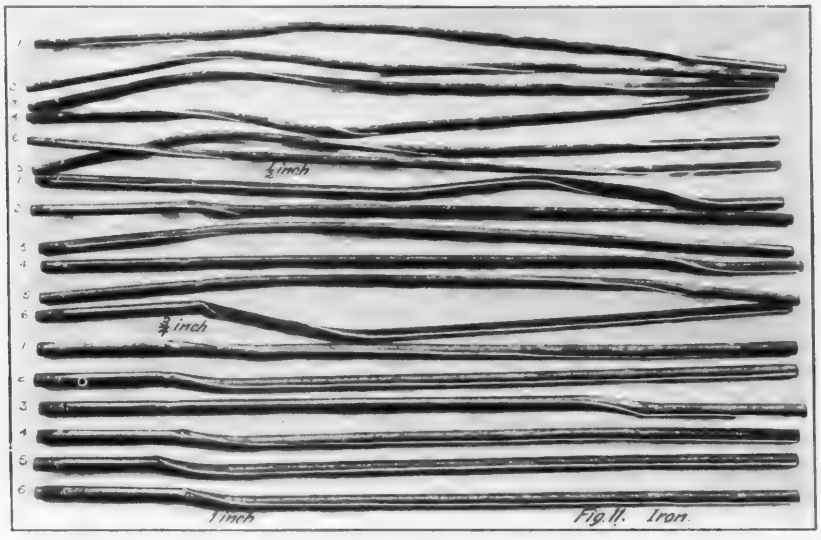

FIG. 11

As soon as a die becomes dangerously dull, it is their duty to refuse to use it any more until sharpened again. If all these interested parties were to enter into the spirit of such a movement, split pipe would soon be a thing of the past.

Gentlemen, these are my opinions of a matter which at this present moment is exciting the interest, and in some ways aggravating the passions, of many members of the heating and ventilating trade. I have tried to get at the truth. I have tried to look at the matter from a disinterested point of view. If I have failed to reach the facts, then I would like to be set right. I have not considered whether wrought iron as a metal is better than mild steel or whether mild steel as a metal is better than wrought iron; I have not made any reference to the durability of wrought-iron pipe or steel pipe; I have simply confined myself to the one topic of dies and split pipe.

Regarding the durability of wrought-iron and steel pipe and the uses to which these pipes may be applied to the best advantage, I believe that a great deal has yet to be learned, and it is the duty of this society to find it out. I believe that most of the pipe on the market to-day is soft-steel pipe. I know that a large amount of pipe has a very short life. Many in the trade claim that steel pipe

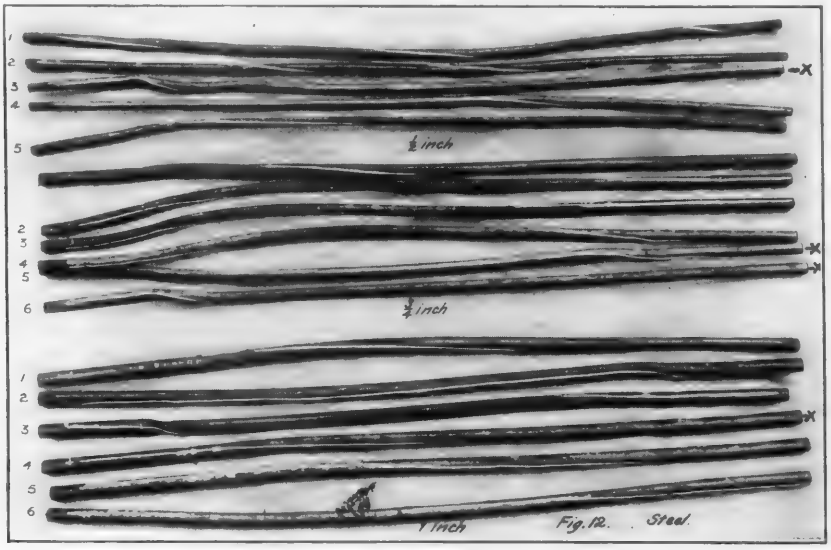

FIG. 12

is not so durable as wrought-iron; others claim the opposite, and many have not noticed any difference. For my part, I have noticed that very few can actually distinguish between the two. I have flattened and broken up pieces of both wrought-iron and mild-steel pipes, and have asked heating contractors, journeymen fitters and the men at the threading machines which of the broken-up samples were wrought iron and which were mild steel, with the almost invariable result that they did not know. In the face of this condition it is not safe to go by opinions. As the durability of the materials composing the body of any structure is the most essential feature, and as piping constitutes the greater part of the structures erected by the members of this society. I believe that the matter of durability of wrought-iron and steel pipes should be carefully investigated and the truth recorded for the benefit of the architects, engineers and pipe-consuming public.

Talking about this now, after having said so much about the correct form of dies to cut and thread pipe, may appear like putting the cart before the horse, but the fact is that an investigation into the relative merits of wrought-iron and modern mild-steel pipe is a work altogether too prodigious for one man; it requires the co-operation of an entire body of men, such, for example, as the American Society of Heating and Ventilating Engineers.

Sizes of Return Pipes in Steam Heating Apparatus

By Jas. A. Donnelly (Member of the Society)

JAMES A. DONNELLY

IT seems a very singular fact that while many papers have been written upon the sizes of steam mains and a quite elaborate treatment of the same subject is given in the works upon steam heating, that return pipe sizes have been so lightly passed by.

Without a single exception, as far as the writer has been able to discover, the text books have given a rule of thumb for determining the sizes of return pipes, stating that the return main must be made much larger than that necessary to carry the water, as there was an indefinite amount of air to be provided for.

Before presenting any method of proportioning return pipes it will be well to state as clearly as possible the exact functions of a return pipe, taking as an example the most difficult of return pipe problems—the dry return for an ordinary gravity return boiler system.

It seems quite clear that the function of the steam main is to carry the steam to the radiating surfaces with as low a loss in pressure as practicable. This is for two reasons: first, that the radiator may be very near the temperature of the steam in the boiler and its efficiency consequently as high as possible; second, that the loss in pressure due to friction shall not be greater than that which can be restored by the available static elevation of the steam main above the water line of the boiler. The return main, which, as before stated, is considered to be a dry one, must not only return the water of condensation to the boilers, but must carry back to the water line of the return where it drops to the boiler and becomes a wet return, the steam necessary to supply the radiation of the return itself, without such loss in pressure as, added to the loss in the steam main, will be more than the before-mentioned static head available between the water line in the returns and the water line in the boiler.

In other words, the dry return is essentially a steam-carrying main, and the large size that is necessary in it is due solely to this fact and not to the air which may be in it, for if the air is an obstruction it should be removed by an air valve.

In a paper read before this society by J. J. Blackmore, an expression was used that has been common in the trade; in speaking of the return pipe he said that "the return must be large enough to equalize the pressure in the system." This statement is a great improvement upon the others referred to, even though it may not be exactly correct.

THREE CLASSES OF RETURNS

There are, generally speaking, three classes of returns for steam heating systems, and as their different functions create different conditions they must of necessity be considered separately.

First, the wet return, where the condensation is carried as much as possible below the water line of the boiler or return tank, or sealed by establishing an artificial water line.

Second, the dry return in a gravity return apparatus, where the water is carried

above the water line, and in a wet return system that part of the return which is above the water line of the returns.

Third, the return of what for want of a more exact classification is called a high difference in pressure system, where the pressure carried is either considerable above atmosphere and the air, water and steam from the return are usually discharged into a vented tank, or where the pressure is substantially atmosphere and the returns are carried in a pipe in which a lower pressure is mechanically maintained.

Considering first the wet return as the most simple form, there is no question but that it has only one function to perform, namely, that of returning the water of condensation.

In a paper presented last year it was recommended that the steam mains should be so proportioned that the drop in pressure should not be more than one ounce in one hundred feet run of straight pipe and, figuring the carrying capacity of wet return pipes for the same drop, their size for steam mains of the capacity given is shown in the annexed table. No allowance has been made for the extra amount of condensation due to heating up the apparatus, as this is usually spread over a sufficient time to allow the water to return without flooding the steam mains. It will be seen from this table that the diameter of the return mains is one-quarter that of the steam mains and their area one-sixteenth. This rule will give the results figured for wet return sizes of air traps and mechanical obstructions in the pipe are avoided.

Where returns are placed above the water line it is, of course, impossible to keep them full of water, due to the fact that they are seldom working to their full capacity and that their tendency to fill is immediately checked by the increased velocity due to rise in static head. The space unoccupied by water is therefore filled with steam, and as it is not possible, even in a horizontal dry return pipe, to heat only a portion of it, the space for the transmission of the steam must be large enough to supply the steam necessary to heat the entire pipe.

The sizes given in the table as being necessary for the water only are about one-half the diameter and consequently have about one-half the superficial exposed surface of the sizes usually employed. It has been found by figuring the surface of the returns in a number of average house installations that it will amount usually to about one-tenth the surface of the radiators; assuming this to be true, or assuming that the extra size of piping called for by the heating of the return main will about double the exposed surface, the next row of sizes in the table is obtained, namely, the size of pipe necessary to carry one-tenth the amount of that carried by the corresponding steam main. The combined area of the two, as given in the next line, is, as will be seen, the size for dry return usually recommended.

There is, however, a possible reduction in size when the return mains are covered. If they are covered so that their radiation is cut down from 25 per cent. to 50 per cent. that of bare pipe, the demand for steam is proportionally less and their size may be reduced accordingly.

The foregoing data seems to furnish a sufficient reason why the present sizes of returns have proven satisfactory, and yet it is not correct except for the smaller sizes of return mains, or those portions nearest the radiators. For as the return approaches the boilers the amount of steam to be supplied to it constantly decreases, and if the steam main is 6 inches and the corresponding size necessary to carry the water 1½ inches, assuming the return 150 feet long and figuring 2-inch pipe as perhaps large enough for carrying both steam and water; 150 feet of 2-inch pipe has about 100 feet of heating surface, and this, added to the capacity of the pipe necessary for water, shows that a 2-inch pipe is ample for the purpose, instead of a 3-inch, as generally used.

Again, figuring a ten-story steam riser 3 inches in diameter, supplying 900 feet of surface, the return for water would be ¾ inch; if it fed a dry return the amount of surface in the main return would have to be figured in determining its size; but if it was dropped into a wet return or sealed and a wet return established, the return riser would only have to be large enough to carry the water and supply itself with steam. Of course, in vertical pipe, one even smaller than ¾ inch would drop the water ten stories; but assuming that it was 150 feet high and it was made 1 inch it would contain only 150 feet of surface and would seem to be large enough; certainly 1¼ inch would be ample.

It would therefore seem that the experiments and observations upon return pipe sizes have been made principally upon dry return systems and radiator connections, and the rule thus established applied to all systems and sizes.

A sort of a paradox that the larger the return mains were made the larger they had to be, and the smaller they were the smaller they might be, would be established were it not remembered that the capacity increases faster than the area, which varies proportionally as the square of the diameter and the exposed surface only directly as the diameter.

The drip from the steam to the return main is another factor that is the cause of much trouble; for as there is always a higher pressure in the steam than in the return main at any drip point, caused by the loss in pressure in the mains beyond that point, the drip pipe conveys steam as well as water and a counter flow is set up in the return main.

A strange condition sometimes exists in dry return main systems when all or nearly

all of the radiators are closed; for if those left open or the drips are not large enough in effective area to keep up the pressure in the return sufficiently high, the return main will be flooded and a very puzzling situation developed. This has led to the practice of connecting all steam and return risers upon the upper floor by a direct pipe or connecting the ends of the steam and return mains where the counter flow, if any, will be up the return riser only.

HIGH DIFFERENCE IN PRESSURE SYSTEMS

Passing now to the class of systems called the high difference in pressure systems, and considering their sizes of returns. The steam main has been cut down very materially in both subdivisions of this class, at some considerable sacrifice of efficiency of radiators. Many times an initial pressure has been reduced several pounds into the radiator at a loss of temperature of about four degrees for every pound drop.

In the systems working above atmosphere and discharging into a vented tank, the returns have very often been tried as a carrier not only of the water and air and the steam required for their own heating, but for the carrying of a large quantity of steam blown up the vent pipe. Systems of this class should undoubtedly have traps upon the radiators or in the branch returns, as from the complicated nature of the figuring involved it is practically impossible to correctly proportion the sizes of the return pipes.

The sizes of return pipes for vacuum return systems were given in a paper read before this society by R. P. Bolton. They were approximated by combining the areas of the discharge passages through the automatic valves. These sizes were somewhat changed in a revision of the paper recently published, in which it was stated that the return should be one-tenth of a square inch in area for each 100 square feet of heating surface supplied by the steam main.

In the Plumbers' and Fitters' Pocket Book the sizes of vacuum returns are given very much the same as in the table for those necessary for the water only. These sizes correspond to steam sizes which run as high as 160 feet a second velocity for a 10-inch pipe, for runs up to 400 feet, and are apparently figured for a one-pound drop for that distance in straight pipe. The sizes of returns given would probably cause three or four times that drop, especially if the steam mains were carrying the radiation tabulated for them; which is about double that carried in gravity systems.

Applying the rule given by Mr. Bolton to the steam table as rated in the P. & F. P. B. would give an 8-inch return for a 10-inch steam main, instead of a 2½-inch. Applying it to the smaller sizes of steam main, it gives about the same size return as for gravity systems.

The sizes of return pipes for vacuum return systems can only be figured when the amount of steam drawn into them is known. As usually proportioned, their superficial surface will average very much the same as gravity systems—about ten per cent. of the radiating surface.

Of course, it is very apparent that if no steam was passed by the automatic valves a very low vacuum would be produced without jet water at the pump. Each square foot of condensing surface in them would only have to radiate 180 B. T. U. to reduce the water to the temperature of 22 inches of vacuum (153 degrees), and the return surface at this temperature would easily have an efficiency of that amount.

Where but a moderate vacuum is produced, with uncovered returns and the use of a reasonable quantity of jet water, it is certain that twenty to twenty-five per cent. of the steam carried out through the steam main is brought back through the return main. In that case the returns would have to be figured large enough to carry the water and that amount of steam with a reasonable drop in pressure.

With several different styles of automatic valves upon the radiators and the returns grouped and carried through controlling devices that gave a low and uniform differential throughout the installation, it has been found possible to withdraw all the air as it accumulated and to keep the steam down that was drawn into the return so that it did not exceed three per cent. and the branch returns up to the differential valves have been figured to carry the water and that amount of steam. The returns from the differential valves to the pump being figured only large enough to carry the water with a reasonable allowance for air and re-evaporation.

Summing up the results of this study of pipe sizes, it would seem that general prac-

TABLE OF SIZES FOR STEAM MAINS

When carrying capacity and	286 sq. ft.	535 sq. ft.	890 sq. ft.	1 950 sq. ft.	3.600 sq. ft	5.900 sq. ft.	12,700 sq. ft.	22,900 sq. ft.	37.000 sq. ft.	55 300 sq. ft.	78,300 sq. ft.
Size of steam main is	2 in.	2½in.	3 in.	4 in.	5 in.	6 in.	8 in.	10 in.	12 in.	14 in	16 in.
Size of wet return	½ "	¾ "	¾ "	1 "	1¼ "	1½ "	2 "	2½"	3 "	3½"	4 "
Size for 10% of steam	1 "	1¼ "	1¼ "	1½ "	2 "	2½ "	3½ "	4 "	5 "	6 "	7 "
Size for dry return	1¼ "	1½ "	1½ "	2 "	2½ "	3 "	4 "	5 "	6 "	7 "	8 "
Size for vacuum return	1 "	1¼ "	1¼ "	1½ "	2 "	2 "	2½ "	3 "	3½"	4 "	5 "

tice often makes the steam mains too small, especially where allowance is not made for the drop in pressure in the return pipe.

That it is impossible to figure return pipe sizes for corresponding sizes of steam mains until some agreement is reached as to the uniform rating of steam mains. A general rating of steam main sizes should be adopted, on the ground that efficiency of radiators should not be sacrificed where the run is short; because it is not practicable to carry steam 500 feet without say 2 or 3 pounds' drop, is no reason why small pipe should be used upon short runs in order to get this drop and inferior efficiency of radiating surface be obtained unnecessarily.

That wet return sizes and dry return sizes, where they connect to wet returns, have usually been made unnecessarily large.

That dry return systems are usually made worse rather than better by extra large sizes of return pipes, and that the main return may be made smaller, especially where it approaches the boiler.

Report of Committee on Collection of Data on Furnace Heating

This committee, composed of Wm. Kent, Frank K. Chew and C. E. Oldacre, says in its report that it formulated a series of questions (reprinted below) concerning furnace heating, with a plan of a residence to be heated, to facilitate the answering of the questions, copies of which were sent to each member of the society. The committee received one set of answers to the questions, although another reply was received by *The Metal Worker* and published in that journal in the issue of December 16, 1905.

The committee asks to be continued and hopes to be able next year to present a more complete report.

Following are the questions that were prepared, and the answers received from Mr. William G. Snow:

THE COMMITTEE'S QUESTIONS

1. What rule or formula would you use for obtaining the following: Heat lost by conduction and radiation from buildings through walls, windows, roofs, etc.? Heat lost by warm air escaping from the building?

2. The sum of these two losses is the total heat that must be supplied to the circulating air by the furnace. What quantity of air should be passed over the furnace in order to absorb this amount of heat? Have you a formula or rule for obtaining this?

3. Suppose the outdoor temperature is zero and the temperature of the hall or other part of the house from which air may be drawn into the cold air box is 60 degrees, what proportion of the air would you draw from the outside and what from inside in an ordinary dwelling house of 8 to 12 rooms?

4. How would you calculate what would be the maximum temperature of the air passing over the furnace? Do you consider this the most advisable temperature of the air at the outlet?

5. What rule or formula have you for proportioning the extent of the heating surface of the furnace to the maximum quantity of heat to be given to the air by the furnace?

6. What rule have you for diameter of fire pot, depth of fire pot, diameter of grate and for maximum rate of combustion per square foot of grate surface per hour?

7. What rule have you for determining area of pipe admitting cold air from outdoors? If pipe is used for inside circulation, what then?

8. What rule have you for area of heater pipes leading from furnace to first, second and third floors?

9. What rule have you for the sum of the areas of all the air outlets of the furnace?

10. What rule have you for the area of the registers?

11. What preference have you as to the location of registers in different rooms?

12. What is your rule for area of foul air outlet from the house?

13. What method have you for insuring entrance and circulation of warm air in every room, particularly those on the side of the house exposed to the strongest cold winds?

14. What is your opinion of warm air heating where a positive means of circulation is used, including both inlet and exit pipes for every room? Do you know of any examples, and where?

15. Design a system of heating by warm air for the accompanying floor plans under the following conditions: The house fronts to the north and the prevailing cold winds are northwest; the lowest outside temperature is 20 degrees below zero. The library has a grate for a wood or coal fire. The house is well built; the windows in the north and the northwest rooms are double. All windows and doors are provided with weather strips and are as air tight as they can be. Show the location of the furnace and location and sizes of all pipes for fresh air, warm air, air circulation out of rooms and foul air exits, size and location of registers. The kitchen and laundry and the two unfinished rooms on the third floor are not supposed to be heated. Give a rule, a reason or formula for the adoption of every detail.

16. Do you live in a furnace heated house? If so, can you furnish any exper-

imental data obtained from the heating system, such as the following:

In extreme cold weather what is the temperature of air outdoors, temperature indoors in different rooms. Size of building. Cubic contents of rooms. Exposure. Number of pounds of coal burned in 12 hours daytime and 12 hours night. Number of pounds of coal burned per season. Temperature of air entering furnace. Temperature of warm air at several registers. Velocity of air in flues and through the registers. Area of inlet and cold air from outdoors. Area of inlet from hall or other parts of the house.

17. What are the principal faults that you have found in warm air heating installations when they have been incorrectly installed?

18. Please suggest any other questions or any modification of the above questions which would tend to bring out useful data in regard to warm air heating.

ANSWERS TO THE QUESTIONS BY WM. G. SNOW

1. Ordinary walls, either 13-inch brick or good frame construction, transmit roughly one-quarter as much heat as the same area of glass. Base the loss of heat through glass with 70 degrees difference in temperature at 85 heat units per square foot per hour, to be increased 25 per cent. for north or west exposure and 15 per cent. for east. The loss of heat through a ceiling separating a room from an unheated attic space may be taken approximately as one-twentieth the loss of heat through the same area of glass with 70 degrees inside and zero out. In other words, the equivalent glass surface of the ceiling, as above stated, is equal to the area of same divided by 20. Each cubic foot of air escaping at 70 degrees in zero carries practically 1¼ heat units.

2. Let the total heat supplied to the circulating air per hour equal H. Assume that the air is heated from 0 to 140 degrees. One heat unit will heat (in round numbers) 50 cubic feet one degree, or will heat 1 cubic foot 50 degrees, or 0.357 cubic foot 140 degrees. Hence H will heat H $\times$ 0.357 cubic foot from 0 to 140 degrees. For example, a furnace with a 26-inch pot giving off 139,000 heat units per hour would heat about 50,000 cubic feet per hour from 0 to 140 degrees.

3. This would depend a great deal upon the use of the rooms at the time. For example, at night, when fresh air in sleeping rooms could be taken in through windows slightly raised, all the air could be returned from the house. In case an unusual number of occupants were present and a good many gas lights were burning, all the cold air should be taken from the outside. Between these two limits any desired portions to meet existing conditions could be adopted.

4. Take, for example, a furnace with a 24-inch grate and, say, 3 square feet of free area for the passage of air; we might safely assume that the velocity would be 275 feet per minute, corresponding to 49,500 cubic feet per hour. A 24-inch grate burning coal at the rate of five pounds per square foot an hour, and assuming the utilization of 8,000 heat units per pound of coal, would give 125,200 heat units per hour transmitted to the air. Since one heat unit will raise 50 cubic feet of air 1 degree, 125,200 heat units would raise 49,500 cubic feet 127 degrees. Anywhere from 120 to 140 degrees would be considered a fair temperature for furnace heat.

5. I would say that 1 square foot of heating surface should not be relied on to give off more than 2,500 heat units per hour. Take the case cited in No. 4. Such a furnace would have in round numbers 50 square feet of heating surface and would give off 2,500 heat units per square foot per hour. It would be better, of course, to rate the furnace at not over 2,000 heat units per square foot an hour. As a rule, furnaces have from 15 to 20 square feet of effective heating surface per square foot of grate. Many furnaces have a great deal more than this, but much of the surface is relatively inefficient.

6. The writer does not understand what is intended as to rule for diameter of fire pot. As to the depth, it should be not less than 12 inches, and the dome above it should be high enough to provide for carrying the pot heaping full of coal in cold weather. I find the maximum rate of combustion advisable to maintain in the coldest weather to be not greater than 5 pounds per square foot per hour. With a cast iron pot this rate is likely to make red-hot surface.

7. I would advise making the cold air box not less than 75 per cent. of the combined area of the hot air pipes, and I consider a larger area of cold air boxes to be better, in view of the greater ease in keeping the house at a moderate temperature in mild weather by supplying a surplus of air through the registers beyond what would be required in the winter for heating the house. If inside circulation is provided I would consider that merely supplemental to the regular cold air supply and would control it by a separate damper or have a swinging damper arranged to automatically cut down the cold air supply when the return air is being used.

8. The theory on which the size of the pipes would be based would require too much space to state fully in connection with these questions. The committee is referred to pages 37, 38, 39 of the treatise on "Furnace Heating," by Wm. G. Snow.

9. The sum of the areas of all the air outlets of the furnace should be not less than 180 square inches to 1 square foot of grate surface.

10. The area of registers naturally follows the determination of the pipe sizes. They should have a net area from 10 to 25 per cent. in excess of the area of the pipe with which they are connected.

11. I believe in short pipes, and believe

it better to locate the registers near the inner partitions, not too far from the furnace, in order that the pipes shall have a sharp pitch and not exceed, say, 16 feet in length as a maximum. The hot air discharged through the registers first goes to the ceiling and then gradually descends around the outside walls and windows, being chilled and falling toward the floor by gravity.

12. In case foul air outlets are provided I would base their area on about a 15-minute air change in the room and a velocity of, say, 250 feet per minute.

13. The furnace should be so located that the pipes will be shortest that lead to the rooms exposed to the coldest winds. Make sure the cold air box slide is sufficiently open to furnish air to fill all the pipes.

14. I have used the positive system of circulation to heat small rooms remote from the furnace, placing a hood over the center of the furnace, connecting the supply pipe with same and bringing the return from the room to the casing of the furnace near the door. The hood mentioned is placed inside the regular furnace top, and insures the hottest air reaching the pipe connected with it. I would not recommend this system for an entire house, as it is human nature for people to save coal at the expense of other things that are really more important, and one of the chief advantages in the furnace heating system properly installed is that the house cannot be heated without supplying it with fresh air.

15. The heights of the several stories are not stated, but assuming the first to be 9 feet, the second 8½ feet and the third 8 feet, I would proceed by computing the outside exposure, and to do this quickly would simply take the exposed walls of the first and second floors, assuming the non-heated portion to about offset the rooms on the third floor that are to be warmed. The total exposure would be about 2,700 square feet, which, according to the table on page 23 of "Furnace Heating," would require a furnace with a 28-inch pot.

I would compute the pipe sizes according to the table on page 38 of "Furnace Heating," and recommend locating the furnace nearly opposite the foot of the stairs to the cellar and under the northwest corner of the dining-room. If the house is to be heated to 70 degrees when the outside temperature is 20 degrees below zero, in case the air is taken from the outside, a furnace of about 46 per cent. greater capacity would be required than to heat the house in zero weather. (See page 51, "Furnace Heating.") It is hardly likely that in such severe weather it would be desired to burn sufficient coal to heat the house with outside air. I would therefore recommend a furnace having a 30-inch pot for the service mentioned.

16. I have lived in furnace-heated houses and give the following experimental data:

With an outside temperature of plus 5 degrees and cold air box wide open temperatures at first floor registers were 116, 114 and 146 degrees; velocity, 418 to 465 feet.

On the second floor register temperatures were 100 to 127 degrees and velocities 252 to 510 feet, the pipes being 6 to 8 inches in size, some of them of considerable length.

With an outside temperature of 24 degrees temperatures at first floor registers 104 and 106 degrees, velocities 306 to 334 feet; on the second floor 95 degrees temperature and 468 feet velocity in a 6-inch pipe.

With an outside temperature of 34 degrees velocity at first-floor register, 280 feet; second-floor, 286 feet.

In a house having a floor plan 29x35 feet the first and second floors heated in a run of 32 days with an average outside temperature of 27½ degrees and furnace having an average firepot of practically 3 square feet, 2 pounds of coal per square foot an hour were burned on each square foot of grate, average, for the entire 32 days of 24 hours each. The house was perfectly comfortable during this time and the furnace was coaled twice a day. During this run there was one cold day when the thermometer went to minus 5 degrees. During these 24 hours 300 pounds of coal were burned at a rate of about 4 35/100 pounds per square foot of grate per hour.

During a 20-day test in a similar house with a furnace having a 22-inch firepot, with an area of 2.64 square feet, average outside temperature 26.3 degrees, the average rate of combustion was 1.84 pounds per square foot an hour. During one cold day when the temperature went to 7 degrees below zero and varied from that to 8 degrees above, 258 pounds of coal were burned, an average of 4.07 pounds per square foot an hour.

The house mentioned had tbout 1,700 square feet of exposed wall and glass, the latter being about one-sixth the total exposure. This house required 10 to 11 tons per season to heat it. The first floor was 8½ feet in the clear and the second floor 8 feet. During the cold day run, with an outside temperature of minus 8 degrees, temperature taken at first-floor registers varied from 119 to 164 degrees and on the second floor from 92 to 133 degrees.

The average of several tests made on the quantity of air entering a furnace with a 24-inch firepot, the cold air box being about 80 per cent. the area of the pipes, showed about 900 cubic feet a minute supply. Tests made on furnaces having about a 24-inch firepot showed in a run of seven days, with outside temperature of 24 degrees, 860 pounds of coal burned. The ashes weighed 90 pounds. Another run of a week, with 23 degrees outside temperature, showed 822 pounds burned, the ashes weighing 91 pounds.

17. Cold air box too small. Flues too shallow. Too little air space in furnace. Insufficient pitch to cellar pipes.

18. I think the committee has gone into this subject pretty exhaustively, and has no suggestions for further questions.

THE HEATING AND VENTILATING MAGAZINE

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IN THE election of Mr. John Gormly, of Philadelphia, as president of the American Society of Heating and Ventilating Engineers, an interesting coincidence arises by reason of the fact that his brother, Mr. Patrick Gormly, also of Philadelphia, is now serving as president of the National Association of Master Steam and Hot Water Fitters. Once before, in 1902, a similar coincidence arose when Mr. Alfred E. Kenrick, of Brookline, Mass., was in the same year and on almost the same day made president of both of these organizations.

Mr. Gormly reaches the office of president after many years of faithful service to the society. He served in the council of the society in 1889-1900. The next year, he was made a member of the Board of Governors, to which office he has been re-elected each succeeding year. His genial nature and sound judgment have always made him an influential factor in the organization's councils, and his elevation to the presidency will give satisfaction to all who have at heart the best interests of the society.

SOME new names were noticed in the list of those who presented papers at the present meeting, and this is as it should be. Our only regret is that there were not more. There are so many features of the work now being done by members of the society that is thoroughly new and of the most valuable character that it would seem that at least more of it might have been presented in the shape of tabulated data. Indeed, so important are a number of the operations lately completed, that we have no doubt they will form profitable topics at the next meeting of the society unless, as in the present case, pressure of work should again prevent their proper preparation.

ARTICLE VI of the society's constitution especially provides that "the Publication Committee shall receive and examine all papers for presentation to the society, and accept for publication such as it may approve." This committee is appointed by the president. Every precaution, therefore, would seem to be taken regarding the admission to the society's records of undesirable matter, either from a professional or commercial standpoint, and especially from the latter. It is hard to raise this question without finding a marked divergence of opinion even on the part of those considered to be the most competent to judge. A remark, for instance, that a speaker may be discussing a system or theory that is calculated to further directly his own business interests, is frequently met with the answer that an engineering society is looking for facts, and whether or not such facts are brought forward in the interests of a member should not signify in the least, as far as the society is concerned. As a

general rule, we are inclined to consider the latter view as the most liberal one. There must be a dividing line, however, and the tendency to steer one's bark close to it, while not peculiar to the heating engineers' society, is one of which the organization has had its share. The society is now twelve years old and at that respectable age is in a position to maintain its transactions according to the best professional standards.

OUR October issue contained an article entitled "The Metric System in England—The American Argument Against It." This argument, which is considered one of the severest condemnations of the use of the metric system for machine work, was advanced by the late Coleman Sellers, of Philadelphia. Since the publication of the article, the subject has received fresh attention on the part of the *New York Herald*, which has started what it calls a crusade in favor of a change in our standard of measurement. "Efforts will be made this winter," it says, "by the introduction of a bill at Washington making the use of the metric system compulsory, to give to the country a scientific and accurate means of carrying on the arts, manufactures and commerce. Pressure at the same time is being brought upon the British Parliament to pass similar legislation, and the Decimal Association, of Great Britain, and other societies are doing all they can to bring about the needed reforms." The writer then goes on to enumerate the many advantages to be gained when the meter supplants the yard stick, and cites the fact that Congress has already decreed that the yard of the United States shall be the 3600/3937 of the standard meter.

The curious fact about all this agitation is the lack of information as to who will repay the billions of dollars now invested in machinery built according to inch standards, and this, as is well known, is but one feature of the tremendous consequences of such an upheaval. It might be asked also how, as the *Herald* says, an "act of Congress would make this a metric nation," in anything except a theoretical sense.

BOUND volumes of THE HEATING AND VENTILATING MAGAZINE, comprising, under one cover, Vols. I and II, are now ready for distribution and will be sent postpaid to any address in the United States on receipt of $3.00. The volumes are suitably bound in cloth and contain a complete cross index.

WE welcome to the ranks of heating and ventilating engineering societies the Association Générale des Ingénieurs, Architectes and Hygienistes Municipaux, of France, Algeria-Tunis, Belgium, Switzerland and the Grand Duchy of Luxembourg. While this society, which has just been formed, by no means confines itself to the matters coming directly under the heading of heating and ventilating, it states, however, as one of its principal objects the "exchange of information and practical ideas that pertain to * * * the ventilation and heating of public buildings." The new society starts out under the patronage of many of the public officials of France, Belgium and Luxembourg and has already established an official organ, *La Technique Sanitaire*, the initial number of which was published January 1.

Reunion of Stockholders of the Heating and Ventilating Magazine Company

In response to a widespread feeling in the heating trade that there was room and a demand for a journal that would be devoted to the subjects of heating and ventilation, a group of men active in the trade took up the matter some two years ago and succeeded in establishing THE HEATING AND VENTILATING MAGAZINE.

The successful launching of this magazine was made the occasion, on the evening of January 5, last, of a reunion of the stockholders of the company at the New Grand Hotel, New York, where a dinner was given in honor of the retiring officers, who have been most actively connected with the work of developing the paper, and of guiding its policy.

The guests of the evening, together with the other stockholders present, assembled at the appointed hour in the lobby of the hotel. After greetings were over the company repaired to a private dining-room in the hotel which had been made ready in advance. The dinner was served on a large round table, tastefully decorated with carnations, American beauty roses, and ferns. Following was the menu:

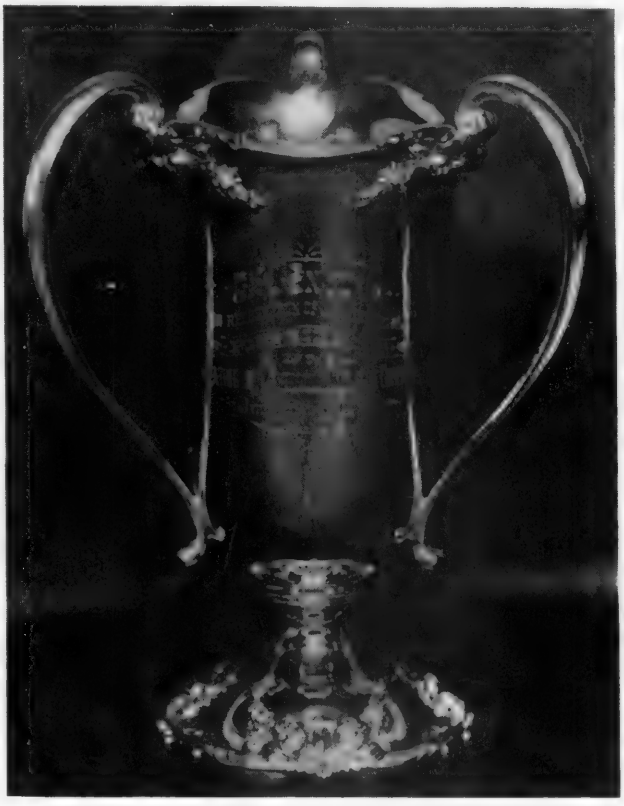
Canape Mathilda
Martini
Stuffed Celery, Jockey Club
Olives Radishes
Chicken Gumbo, Creole
Boiled Florida Shad and Roe
Haut Sauterne
Cucumbers Chive Salad
Potatoes Brabant
Sweetbreads sous Clocke
a l'Eugénie
Punch a la Princesse
Roast Stuffed Squab
sur Canape
Pol Roger (1893)
Roman Salad en Chiffonade
Biscuit Napoleon
Petits fours Assorted Cakes
Café Noir Bénédictine

As soon as the cigars were lighted and the diners had settled back to sip their coffee, a waiter appeared bearing a rather mysterious-looking package, which he set down before Mr. Henry L. Hall, the vice-president of the company. Mr. Hall, however, seemed to understand the situation, for, with a twinkle in his eye that did not escape the notice of those who were aware of what was coming, he turned to Mr. C. B. J. Snyder, who was seated at his left, and said, in part:

"Mr. Snyder, a duty has devolved upon me that is at the same time a very great pleasure. I am asked to turn over to you this box, which contains a slight token of the appreciation of your efforts in behalf of the establishment of THE HEATING AND VENTILATING MAGAZINE, and of your services as president of the company during the past year."

The opening of the box disclosed a three-handled Gorham silver loving cup seven inches high, bearing the following inscription:

C. B. J. SNYDER
In recognition of his services as
PRESIDENT
of the
Heating and Ventilating Magazine
Company
January 5th, 1906



LOVING CUP PRESENTED TO MR. C. B. J. SNYDER, in Recognition of his services as President of the Heating and Ventilating Magazine Co.

The presentation of the loving cup came wholly as a surprise to Mr. Snyder, but quickly recovering himself, he said, in part:

"Gentlemen—Deeply as I appreciate receiving this cup, I feel that I do not deserve it. All of you have shown the same interest as I in the enterprise with which we are connected, and some of you, I know, have devoted far more time and thought than I to the development of the magazine.

"I accept your gift with deep appre-

ciation, and now that it is mine, I will say that it is the first real loving cup I have ever owned." (Laughter.)

While Mr. Snyder was speaking, two additional boxes similar to the one containing the cup given him were quietly brougnt in and deposited at the side of Mr. A. S. Armagnac, the secretary of the company. At the conclusion of Mr. Snyder's remarks, Mr. Armagnac placed the two newly-arrived boxes on the table and, in a few appropriate words, presented one to Mr. Hall and the other to Mr. William M. Mackay, the retiring treasurer.

It was apparent to both the latter that they were to share in the "surprise" of the evening, and amid much laughter and congratulations, the boxes were opened, disclosing two silver Gorham loving cups, each of the same pattern and similar to the type of cup presented to Mr. Snyder.

Mr. Hall's cup bore the inscription:

HENRY L. HALL
In recognition of his services as
SECRETARY
of the
Heating and Ventilating Magazine Company
January 5th, 1906

LOVING CUP PRESENTED TO MR. WILLIAM M. MACKAY, in recognition of his services as Treasurer of the Heating and Ventilating Magazine Company

and on the cup presented to Mr. Mackay was engraved:

WILLIAM M. MACKAY
In recognition of his services as
TREASURER
of the
Heating and Ventilating Magazine Company
January 5th, 1906

Bumpers of champagne were ordered, and amid much merriment, healths were drunk from the loving cups to the retiring president and treasurer and to the continued prosperity of THE HEATING AND VENTILATING MAGAZINE and to all connected with it.

The party broke up at a late hour after an evening that was voted by all to be an occasion long to be remembered.

The place of Mr. Snyder, as president, and Mr. Mackay, as treasurer, were filled, at a subsequent meeting of the Board of Directors, by the election of Henry L. Hall, as president; B. Harold Carpenter, as vice-president, and A. S. Armagnac, as

LOVING CUP PRESENTED TO MR. HENRY L. HALL, in recognition of his services as Secretary of the Heating and Ventilating Magazine Company

secretary-treasurer. The Board of Directors will be composed of the following: R. C. Carpenter, Wiltsie F. Wolfe, C. B. J. Snyder, Henry L. Hall, B. H. Carpenter, F. A. Williams and A. S. Armagnac.

NATIONAL ASSOCIATION OF MASTER STEAM AND HOT WATER FITTERS

The following are the officers recently elected by the Master Steam and Hot Water Fitters' Association of the State of Pennsylvania: Wm. P. Thomson, Philadelphia, president; P. F. Maginn, Pittsburg, vice-president; P. Gormly, Philadelphia, treasurer; M. G. Sellers, Philadelphia, secretary. The Executive Committee are: William O. Scull, Reading; B. Harold Carpenter, Wilkes-Barre; John P. Smith, Philadelphia; George B. McIntyre, Erie; C. Ed. Hantz, York. John C. F. Trachsel, Philadelphia, sergeant-at-arms.

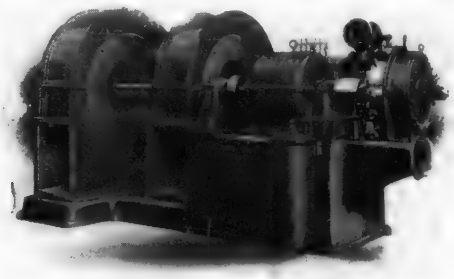
Following closely upon the banquet, given by the Newark (N. J.) Master Steam and Hot Water Fitters' Association, in Newark, December 6 last, comes the announcement of a movement to organize a State Master Fitters' Association for New Jersey. At that dinner fully 150 master fitters of Newark and vicinity were present and, as President Gormly, of the National Association, remarked in his post-prandial address, the occasion served to bring closer together the master fitters of that section than, perhaps, any other one thing could do.

NEW DEVICES

The Sirocco Fan

The December issue contained a short description of the heating and ventilating system of the new steamship "Amerika," in connection with which it was mentioned that the fans used were of the Sirocco type.

The fans, which have only recently been introduced on the market in this



SIROCCO BLOWER DIRECT CONNECTED TO TURBINE ENGINE

country, are the invention of Mr. S. C. Davidson, of Belfast, Ireland, and up to the present, have been principally manufactured in that country, and are now very largely in use in Great Britain, having been adopted, among others, by the British Admiralty. A large number of successful installations are, however, in operation in America; notably for forced draft equipments and for heating and ventilating of large buildings, public schools, engine rooms, etc.

The fans themselves, it is claimed, represent a departure in the construction of this class of apparatus, the blades being very numerous and narrow in dimension, and the principal features in the fans are the large areas for inlet and outlet of the air, and saving of space and weight.

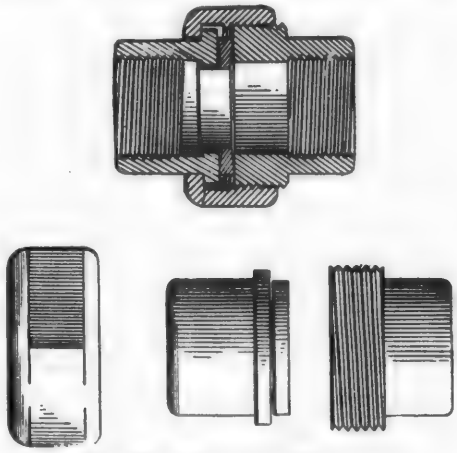
The accompanying illustration shows a direct connected unit consisting of a 150 H. P. De Laval Turbine having two parallel shafts, on each of which a Sirocco blower is mounted. This set, however, is for high pressure work, the fans being capable of delivering about 30,000 cubic feet per minute at 20 inches water gauge at 1,200 revolutions per minute. These fans can be furnished for supplying any required volume at lower pressures which apply in ordinary ventilating work, and very high efficiencies have been obtained with same in tests on actual installations. The fans are supplied by the Sirocco Engineering Co., 22 Thames street, New York.

Vapor Vacuum System of Heating

A new method of steam heating known as the Gorton Vapor Vacuum System has recently been placed on the market. It is designed to accomplish the usual results in such systems and also to regulate the heat in any one radiator without any extra piping. By the use of an automatic drainage valve, which is placed on the return of each radiator and an automatic relief valve, both for air and water of condensation, which is connected to the steam and return mains in the cellar, steam can be circulated under a vacuum, at a temperature of 100° F. or at any temperature up to 238°. By this means, also, the heat in any radiator is controlled by graduating the opening of the radiator valve. Mr. James A. Donnelly, of New York, was associated in the development of the apparatus, which is manufactured by Gorton & Lidgerwood Co., 96 Liberty street, New York.

A New Pipe Union

An invention, designed by J. O'Meara, the inventor of the O'Meara valve, to secure a fluid-tight union for pipes which are subjected to expansion and contraction through the influence of service, has lately been patented and is illustrated herewith. The invention, which is a remarkably simple one and yet likely to fill a long-felt want, consists of a washer of soft metal, such as brass, of angular or other cross section, which has contact edges intended to be fixed loosely to one member of the coupling so as not to be-



FLUID TIGHT UNION FOR PIPES

come detached in handling. This washer is capable of being compressed between the ends of the pipe, as they are drawn together, and thus make a fluid-tight joint. One of the advantages of the invention is the tubular extension, permanently expanded, within one of the pipes which is thereby movably but fixably secured, to said pipe so as to resist accidental detachment in handling the pipe.

TRADE AND MISCELLANEOUS NOTES

New Books

Questions and Answers on the Practice and Theory of Steam and Hot Water Heating is the title of a 90-page book, by R. M. Starbuck, of Hartford, Conn. It constitutes a sequel to his other book on sanitary plumbing, also written in conversational style. Mr. Starbuck has sifted down into small compass all of the necessary information used in ordinary steam heating work, and supplements this information with upwards of 25 illustrations. A 19-page index enables the reader to turn at once to any particular subject. The book sells for $1.00. Size, 6¾x4¼ inches.

Notes on Heating and Ventilation, by John R. Allen, junior professor of mechanical engineering in the University of Michigan, is a book of 152 pages in which is presented in a readable manner practically all of the information necessary to guide the intelligent steam fitter in the installation of heating and ventilating apparatus. Prof. Allen also treats of the subject of exhaust steam heating, but has only a paragraph for the much-discussed subjects of vapor and vacuum heating. The book is illustrated and contains many useful tables. $2.00. Domestic Engineering, Chicago.

The Architects' Directory and Specification Index for 1905-6 has come to hand. This book is probably the most up-to-date architects' directory published and this latest edition bears out its well-earned reputation. The contents include a list of architectural societies, architectural schools, building departments of the principal cities in this country, schedule of charges of American Institute of Architects, together with a list of the periodicals of interest to the architect and builder, in which is included THE HEATING AND VENTILATING MAGAZINE. Pp. 176. The book is published at $2.00, net, by William T. Comstock, 23 Warren street, New York.

Manufacturers' Notes

Manuel-Smith Heating Co., East Minneapolis, Minn., are building a new factory building, 40x100 feet, for the purpose of manufacturing and installing the Smith System of Heat Retention and Ventilation.

Trimont Mfg. Co., Roxbury, Mass., had the annex to its plant destroyed by fire Thursday, December 7. The loss will probably be about $30,000.

Post yourself on Vacuum Heating
MORCAN PATENTS
NEW LINE OF CATALOGUES WRITE AT ONCE FOR FULL PARTICULARS AND PRICES
CHICAGO MINNEAPOLIS
Kellogg Mackay Cameron Co.
SOLE OWNERS
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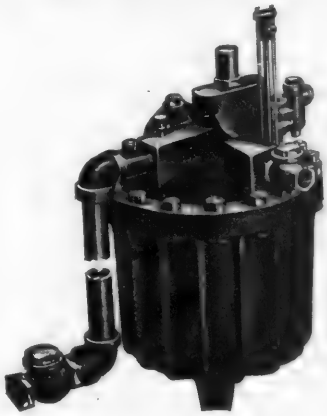

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have been the STANDARD for over THIRTY-TWO YEARS. For returning water under pressure to the boiler, they will perform this duty fully as well, and in many cases better than the so-called steam loop.

Send for circulars A, B, C and D.

MANUFACTURED BY
ALBANY STEAM TRAP CO., ALBANY, N.Y.
FREDERICK TOWNSEND PRESIDENT
JAMES H. BLESSING GEN. MGR.

Toledo Pipe Threading Co., Toledo, Ohio, has increased its capital stock from $10 000 to $50,000.

Curtis & Curtis Co., Bridgeport, Conn., have opened an agency at 60 Center street, New York city, with H. H. Walker in charge.

L. O. Koven & Bro., New York, have recently bought part of the Reinecke estate, in Newark, N. J., for the purpose of erecting a new plant to manufacture tanks and special plate and sheet steel work.

American Radiator Company's New York branch will occupy the new Arco building on West Forty-second street, upon its completion at an early date.

University of Wisconsin, Madison, Wis., is planning to build a new heating and power plant to cost about $250.000.

Schaffer & Budenberg, New York city, have bought a new plant at Foxboro, Mass. They will also fill orders at their Brooklyn plant.

Union Boiler Company, Pennington, N. J., is the title of a new corporation which has taken over the plant and equipment of the Pennington Foundry & Heater Company. The officers are: President, Charles O. Lyon; Treasurer, Edward Benedict; Secretary, Max Mullhall, all of the Thatcher Furnace Company, Mr. Lyon being the president of the latter concern. The plant is composed of a number of large buildings which are noticeable on account of their stone construction. It is the intention to make additions to the plant, enabling it to rank with some of the largest boiler plants in the country. It is announced that the new company is distinct from the Thatcher Furnace Company, although it has been arranged to transfer to Pennington the manufacture of much of the Thatcher Company's boiler output, which are now made at the latter's plant in Newark.

Business Changes

Miller Foundry & Specialty Co., No. Tonawanda, N. Y., has been incorporated with a capital of $30,000: foundry, plumbing and heating. Following are the incorporators: Alice M. and George O. Miller and Amos N. Gulf, of No. Tonawanda.

R. W. Hillman Co., New York, has been incorporated with a capital of $10,000 to manufacture heating and ventilating apparatus. The incorporators are: Richard Ward Hillman, Herman I. Sorensen and John C. Davis, all of New York.

Frank Hagny Co., New York city, formerly of Sullivan, Ill., has taken up quarters in the St. James building, Broadway and Twenty-sixth street, where the heating and ventilating business will be continued. The stock in Sullivan has been sold to L. T. Hagerman & Co.

R. Hoehm Co., Brooklyn, N. Y., has been incorporated with a capital of $100,000 to manufacture thermometers. The incorporators are: Gustav Wurtenburg,

Wing's Disc Fans

FOR FORCING OR EXHAUSTING AIR

The Original
The Strongest
The Most Efficient

Send for Catalogue and Reference List of some 800 names of users.

MANY THOUSANDS IN USE

L. J. WING MFG. CO.
136 Liberty Street, New York

Manufacturers of

WING'S Disc Fan and Combinations
WING'S Fans and Turbine Engines for Forced Draft, etc.
WING'S High Speed Steam Engines
WING'S Acetylene Generators, etc.

Isaac Mayer and Charles Fried, all of Brooklyn.

Harrisburg Heating and Plumbing Co., Harrisburg, Pa., has been incorporated. The incorporators are: John W. Shaw, Sam Barter, Harry Wills, H. A. Murphy and B. F. Welch.

Connecticut Boiler Mfg. Co., New York, has been incorporated with a capital of $5 000 to manufacture boilers, etc. The incorporators are: Ernest J. Magen, of New York; George A. Honnecker and George W. Behrens, of Jersey City.

H. & M. Valve Co., New York, has been incorporated with a capital of $75,000. The incorporators are: J. A. Stursberg, Arthur Herschmann and C. C. Upham, of New York.

New Incorporations

Sauer & Gorgen, Albany, N. Y., plumbing, roofing, heating, gas fitting, etc.; capital, $1,000. Incorporators: Henry A. Sauer, Philip Gorgen and Edward Daly, all of Albany.

Saxonburg Heat & Light Co., Saxonburg, Pa.; $5,000. Directors: John B. Patterson, Freeport; W. H. Snyder, Carbonblock; Gottlob P. Feil, Pittsburg; W. H. Knock, Saxonburg; J. F. Anderson, Butler.

Simpson Heater Co., Newark, N. J., has been incorporated with a capital of $10,000. The incorporators are: A. Simpson, Jesse A. Flory, C. L. Flory, W. A. Smith and Cora M. Smith.

Dixon Water System Co., Chicago, Ill., has been incorporated with a capital of $20,000 to install heating, lighting and power plants. The incorporators are: George E. Dixon, Horace H. Dixon and Sidney S. Gorham.

Modern Plumbing, Heating & Decorating Co., Westfield, N. Y., has been incorporated with a capital of $10,000. The incorporators are: Harry L. Russell and Frank S. McHarg.

Knowlton Packing Co., Boston, Mass., has been incorporated with a capital of $40,000. The incorporators are: Edward B. Metcalf, Charles W. Smith and Fred. A. Ewell.

McMann Co., New York city, has been incorporated with a capital of $20,000 to manufacture pipe fittings, plumbers' and gas fitters' supplies. The incorporators are: Charles A. McMann, Margaret H. McMann and C. A. Hupfel, all of New York city. This firm, it is announced, is distinct from Thos. R. McMann's Sons, also of New York.

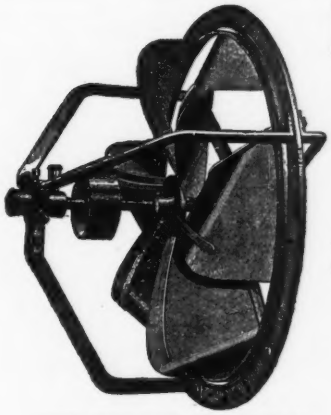
Kansas City Heating Co., Kansas City, Mo., has been incorporated with a capital of $250,000.

Miscellaneous Notes

International Heater Co., Utica, N. Y., announces the appointment of Judson A. Goodrich as manager of the New York branch of its business at 1 Madison avenue.

Little Rock Heating Co., Little Rock, Ark., has failed. J. A. Trawick has been appointed receiver. The company is bonded for $250,000, of which amount $174,000 is held by local concerns.

Santa Fe Railway, Temple, Tex., is having a new steam heating and hot wa-



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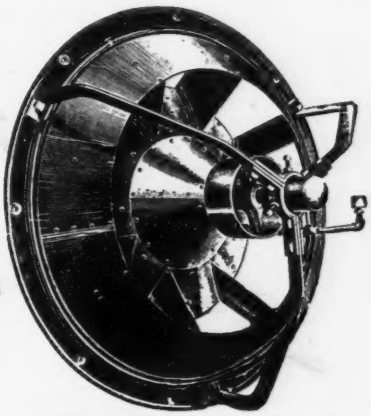

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ter plant installed in the Railway Y. M. C. A. building. The plant will cost about $2,000.

William G. Snow has recently resigned his position with Francis Brothers & Jellett to accept the management of the New England office of Warren Webster & Co., of Camden, N. J., with offices in the Penn Mutual building, Boston, Mass.

Frank C. McLain Company, New York, has removed to Canton, Ohio, where its manufacturing department will also be located. The New York office of this firm is now at 242 Fourth avenue.

New Firms

Lookout Steam Heating Co., Chattanooga, Tenn., is the name of a new firm recently organized to conduct a steam and hot water heating business. The firm is composed of Leo Strahle, H. H. Peek and W. Whitwam.

Utica Superheater Co., Utica, N. Y., has been organized to manufacture a steam superheater. The officers are: W. G. Stone, president; W. A. Watson, vice-president, and H. F. Mann, secretary and treasurer.

Harrisburg Heating & Plumbing Co., Harrisburg, Ill., is the name of a new firm which will carry on a general plumbing and heating business.

Contracts Awarded

A. W. Southwell & Son, Cleveland, Ohio, plumbing and heating the new four-story annex to the Northampton.

Middlesex Machine Co., Lowell, Mass., steam heating the Bigelow Carpet Company's new mill.

Cleghorn Co., Boston, Mass., steam heating the addition to the Gillette Safety Razor Company's factory at South Boston.

Crook, Horner & Co., Baltimore, Md., heating the new Washington apartment house. The contract price is $8,000.

Crookston Plumbing and Heating Co., Crookston, Minn., plumbing and heating the new building at the Crookston Agricultural School, at their bid of $2,026.

Stewart & Hayden, Burlington, Ia., plumbing and heating the McConnell building.

Camden Heating Co., Camden, N. J., installing a heating plant in Building No. 18 at the League Island Navy Yard, Philadelphia, Pa. The contract is worth $4,611.

W. W. Patten & Co., Pittsburg, Pa., heating the First National Bank of Monessen.

J. H. Cooney, Harrison, N. J., heating the plant of the New Jersey Worsted and Spinning Company, at Garfield.

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Louis Bremer, Mendon, Mich., installing a heating plant in the new Carnegie library.

Racine Ventilator Co., Racine, Wis., installing ventilators in the public library.

W. H. Denslow, Waverly, N. Y.. steam heating the new building at Wellsburg.

Ross, Dye & Cowgill, Central City, Neb., installing steam heating plant at the Nebraska Central College, at their bid of $1,700.

Charles Hughes, Rockford, Ill., plumbing, heating and ventilating the building to be occupied by the American plant at Momence.

Barlow Bros. Co., Waterbury, Conn., installing a power plant and heating system, boilers, engines, pumps, etc., in J. E. Smith & Co.'s new mill on Benedict street.

Pelton Brothers, Herkimer, N. Y., installing a heating plant in the Van Alstyne Block.

Allen Meyers & Co., Rock Island, Ill., installing a heating system in the new High School at Clenton, Ia.

American Engineering Co., San Francisco, Cal., remodeling the steam heating, lighting and hydraulic elevator plant of the San Francisco Savings Union buildings.

Cleveland Steam Fitting & Supply Co., Cleveland, Ohio, heating the handsome residence being erected on Shaker Heights for Mrs. Painter.

William Amer Plumbing & Heating Co., Menasha, Wis., heating the new Water Works Station.

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Wells & Newton Co., New York, installing a new ventilating system in the first floor of the Union Station, Pittsburg, Pa., for the Pennsylvania Railroad Company.

Struss & Maiser, Allegheny, Pa., plumbing and heating the Children's Home.

Hawkins Bros., Painsville, Ohio, heating the Y. M. C. A. Their bid was $1.700.

Pacific Heating and Ventilating Co., San Francisco, Cal., installing complete blower systems for the California Sugar and White Pine Agency's new planing mill at Verdi, Nev.; the Medera Sugar Pine Company's factory at Medera, Cal.; the Standard Lumber Company's plant at Sonora; the Capital Box Company's factory at Sacramento.

Fuller & Warren Co., Boston, Mass., steam heating the school house at Lakeport, Laconia, N. H.

H. F. C. Booth Co., Bridgeport, Conn., steam heating the new addition to the building of the Sea Side Club.

Moser Heating Co., Hagerstown, Md., heating the Catawba College, Newton, N. C.

Elliot & Barry Engineering Co., St. Louis, Mo., heating the new Missouri Valley College at Marshall, Mo.

Wm. F. Wilson & Co., San Francisco, Cal., have been awarded the contract for plumbing, steel tanks, hose reels, stand pipes and heating system, by the California Casket Company.

American Heating & Ventilating Co., Pittsburg, Pa., heating four school buildings now being built at McKeesport, Pa.

Harris Brothers, Provo City, Utah, construction of the great bathing pool at Saltair, Utah.

Cooper Brothers, Springfield, Mo., plumbing and steam heating the Hotel Hattiesburg, at Hattiesburg, Miss.

C. R. Stricker, Columbia, Pa., heating the Manor street school building, at their bid of $1,306.

A. B. Fels, Portland, Me., steam heating St. Mary's church at Orono.

Fargo Plumbing and Heating Co., Fargo, N. D., installing a heating plant in the Central Hotel.

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